

**U.S. CARIBBEAN QUEEN CONCH (*Strombus gigas*)
DATA UPDATE WITH EMPHASIS ON THE COMMERCIAL
LANDINGS STATISTICS**



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Table of Contents

1. Abstract
2. Introduction
3. Objectives
4. Relevant background information.
 - 4.1. Description of the fisheries
 - 4.1.1. U.S. Virgin Islands
 - 4.1.2. Puerto Rico
 - 4.2. Historical trends in the queen conch fisheries of the U. S. Caribbean
 - 4.2.1. U.S. Virgin Islands
 - 4.2.2. Puerto Rico
 - 4.3. Regulations
5. Summary of the queen conch information from the U.S. Caribbean available at the SEFSC/NMFS and useful for stock assessment.
6. Analysis of biometric data.
7. Summary of the landings statistics for the commercial queen conch fisheries of the U. S. Caribbean
 - 7.1. U.S. Virgin Islands
 - 7.1.1. Description of the data
 - 7.1.2. Approach
 - 7.1.3. Results
 - 7.1.4. Summary. U.S.V.I.
 - 7.2. Puerto Rico
 - 7.2.1. Description of the data
 - 7.2.2. Approach
 - 7.2.3. Results
 - 7.2.4. Summary. Puerto Rico.
8. Conclusions
9. Literature cited.

1. SUMMARY

The queen conch, *Strombus gigas*, is an important component of the multigear and multispecies fisheries of Puerto Rico and the U.S. Virgin Islands. There is great concern in the region regarding the current condition of the conch populations, as signs of overfishing have long been detected. Formal analyses of the existing information are needed to evaluate stock status and to assess the effects of the existing management regulations.

The goal of this study was to compile, review, classify and summarize the biological and fishery information on Caribbean queen conch useful for stock assessment. Particular emphasis was placed on filtering the commercial queen conch landings statistics datasets. Descriptive analyses of the conch fisheries were performed by island, including biometric analyses, catch-composition, time-series of catch and effort, classification of the targeted and non-targeted sectors of the fishery, estimation of the number of active fishermen, and estimation of nominal catch rates. The official datasets are still being updated and processed by the competent departments, so the results presented here are preliminary and only intend to provide a setting to guide future analyses of these fisheries.

2. INTRODUCTION

The queen conch, *Strombus gigas*, is a valuable fishery resource in the Caribbean, both for its meat and its shell. Research efforts in the region have provided significant insight into much of the life history, growth and biology of the species, and into some of the effects of fishing pressure on the stocks (Wood and Olsen, 1983; Appeldoorn 1991, 1992; Appeldoorn and Rodriguez, Eds., 1994).

The queen conch resources of Puerto Rico and the U.S. Virgin Islands have been reported as overfished and in decline since the late 1970's (Wood and Olsen, 1983; Appeldoorn, 1991, 1992). Concern with the status of the stocks encouraged the Caribbean Fishery Management Council (CFMC) and the National Marine Fisheries Service (NMFS) to analyze the queen conch landings statistics and to review and implement fisheries-independent surveys to assess stock abundance, age and size composition, and fishing effort (Wood and Olsen, 1983; Boulon, 1987; Friedlander et al., 1994; Rosario, 1995; Appeldoorn, 1996; Friedlander 1997, Rivera, 1999). In addition, various international meetings have been held to discuss approaches for the assessment and management of this species. They have highlighted the data limitations that prevail throughout the Caribbean (Appeldoorn and Rodriguez, Eds. 1994, CARICOM 1995, CFMC 1996; CFMC/ CFRAMP 1999). Results from these studies have revealed that the resource is indeed heavily exploited and that sustained harvest levels cannot be attained unless effective management measures are implemented and enforced.

In response to severe overfishing of queen conch stocks in the U.S. Caribbean, a number of management regulations have been implemented since 1984 in the U. S. Virgin Islands (Beets and Appeldoorn, 1994), but their success has scarcely been evaluated. Commercial landings data have continued to be collected since the last assessments (Appeldoorn 1992a; CFMC/ CFRAMP 1999), and independent surveys have

continued to produce valuable information on stock abundance and age structure (Friedlander et al., 1994; Rosario, 1995; Appeldoorn, 1996; Friedlander 1997, Mateo 1997; Mateo et al., 1998; Rivera, 1999). Updated analyses that include this new information are needed to evaluate the current status of the queen conch stocks and to quantify the effects of the existing management strategies.

The Southeast Fisheries Science Center of the National Marine Fisheries Service (SEFSC/NMFS) has undertaken the task of compiling, reviewing, and analyzing the existing information for the fishery resources of Puerto Rico and the U.S. Virgin Islands. The general objectives of the Caribbean Stock Assessment Project are to compile the existing information, to collaborate in the process of assembling standardized data sets, and to analyze this information.

The goal of this report is to review, summarize and integrate the relevant information available up to year 2001 on the queen conch resources of Puerto Rico and the U.S. Virgin Islands, such that formal quantitative assessments may be conducted in the near future. Special attention will be paid to the commercial landings data, since they will ultimately constitute the core of these analyses.

3. OBJECTIVES

The objectives of the present study are:

1. To compile, review and classify the information on Caribbean queen conch available at the SEFSC/ NMFS.
2. To summarize the information useful for stock assessments.
3. To compile and organize the commercial queen conch landings data sets.
4. To summarize commercial queen conch landings and effort statistics for 1986-2000 from Puerto Rico and the U.S. Virgin Islands.
5. To compare the descriptive statistics drawn from the commercial trip-ticket data to the information from previous surveys (catch composition, number of fishermen/boats operating in the fishery, fishing effort estimates, catch-per-unit-effort, etc.)
6. To provide a setting to guide future analyses of these fisheries.

4. RELEVANT BACKGROUND INFORMATION

4.1. Description of the fisheries

4.1.1. U.S. Virgin Islands

Available conch habitat to support the conch fishery in the U.S.V.I. is limited to waters of the surrounding shallow insular shelf platforms. The islands of St. Thomas and St. John share the same geological platform and their conch fishery is generally

considered together. The island of St. Croix lies on a separate platform and its fishery is generally analyzed separately (García-Moliner, 1997).

The conch fishery in the U.S. Virgin Islands is mostly concentrated around St. Croix. It is artisanal in nature and consists of about 28 commercial fishermen (16 full-time and 12 part-time) fishing from outboard-powered, 17-foot long fiberglass vessels. Eighty percent of the fishermen use SCUBA gear to harvest conch and 20 % use free diving. All trips are made on a daily basis with the fishermen returning to market their catch by early afternoon. On average, they make 3.2 trips/week with 2 fishers on board and using 3.6 scuba tanks/trip. Fishing occurs in territorial waters within 3 miles from shore. Commercial fishing effort is concentrated in offshore waters from 17 to 79 ft in depth. Recreational fishing still occurs in shallow seagrass backreef embayments, where the resource has been nearly depleted from prior commercial use. Despite management regulations, most fishermen do not land conch alive and in the shell (CFMC/CFRAMP 1999).

A survey of conch fishers (Rosario 1996) showed that none of the fishermen interviewed in the U.S.V.I. target conch exclusively; in St. Croix 96% target conch and lobster and 4% target octopus too. Other species harvested include reef fishes and coastal pelagic species.

In St. Thomas and St. John, conch is incidental to the main fish catch. Other species targeted include lobster and octopus. There are no full-time conch fishermen and 23 part-time fishermen (20 in St. Thomas and 3 in St. John), who fish for conch only upon request from customers. The most common method of harvesting is SCUBA (38%), followed by free-diving (29%) and a combination of both (24%). Mean trips per week are 3.1 , with a mean of 0.1 tanks/trip. The usual catch for two fishermen is 50-100 conchs in about two hours of fishing effort (Rosario 1996, Rivera 1999).

Abundance surveys conducted in the U.S.V.I. in 1981, 1985 and 1990 showed a significant decline in conch densities from 37 to 11 conch/ha. A fourth survey conducted around St. John in 1996 (SEAMAP-C), also showed a general decline in abundance despite management regulations (see Figures 1 and 2), but juvenile abundance appeared to increase, maybe as a result of the minimum size limits and/or deep water habitats acting as refugia from fishing (Wood and Olsen 1983, Friedlander et al. 1994, Friedlander 1997). Results from the last SEAMAP-C survey conducted in the Summer 2001 are expected shortly and will be crucial to determine current trends in population abundance.

4.1.2. Puerto Rico.

Major areas for conch fishing in Puerto Rico are on the southwest coast, the south coast, and the east coast, including the island of Vieques. There are approximately 209 conch fishermen, both full-time and part-time (Rivera 1999). From Rosario's (1996) survey, of 166 interviewed fishers, 11% exclusively fished for conch and 88% target other species, mainly spiny lobster (75%), octopus (33%) and various other finfish and shellfish. They harvest conch by SCUBA (66%), skin diving (21%) or both (11%), at depths over 90 ft. On average, 3.7 trips are made per week with 2 or more fishers/boat and 3.4 tanks/fisher/trip. Fishermen use boats averaging 18 ft (5.5m) in length, equipped

with outboard engines and make daily trips. The shells are removed at sea and only the conch meat is landed.

Rosario's (1996) survey also identified areas where juvenile and adult conch were found, as well as areas presently fished (conch strata), and no longer fished. Based on this information, a fishery-independent survey (SEAMAP-C) was conducted in 1996. Appeldoorn (1996) found mean densities of 5.68 and 7.28 conch/ha in conch strata in the west and east coasts of Puerto Rico, respectively (see Figure 1). A prior study conducted by Torres Rosado (1987) off La Parguera, on the southwest coast, found 8.1 conch/ha (García-Moliner, 1997).

4.2. Historical Trends in the Queen Conch Fisheries of the U. S. Caribbean

4.2.1. U.S. Virgin Islands

Commercial landings in the U.S.V.I. have been recorded since the early 1970's. The total and queen conch landings between 1986-1999 provided in the Cooperative Statistics (C/S) Annual Reports (DFW/NMFS, 1989-2000) are presented in Table 1 and Figure 3. Longer time-series were reconstructed from various sources for the queen conch fishery and are illustrated in Figure 5. The conch landings in St. Croix (Figure 5a) suggest a constant increase between 1967-1979, when one of the largest levels was recorded at 60,000 lbs. Since 1980 sharp declines started to occur, followed by marked fluctuations and gaps in the information. In the 1990's, large fluctuations continued to occur, with mean landings in the vicinity of 20,000 lb. A sharp increase is observed in year 1997-1998, when the largest landings near 73,000 lb were recorded. In 1999, landings decreased again to 44,300 lb. Some of these fluctuations may be explained by the implementation of management regulations starting in 1984 (described in the following section) and inconsistencies in the data sets. Some of this information may need to be corroborated.

Fewer and less consistent reports of landings statistics were available for St. Thomas/St. John, as shown in Figure 5b. Overfishing led to a 5-year closure through 1992. Following the closure, landings fluctuated around 3,000-5000 lbs between 1993-1998. A sharp increase to 23,800 lb is apparent in 1999.

Data on fishing effort is sparse and inconsistent for the U.S.V.I., so historical trends could not be reconstructed from the literature. There is no information regarding the recreational landings of queen conch.

4.2.2. Puerto Rico.

A program to collect detailed statistics of the Puerto Rican fishery was started in 1967. Since then, there have been several periodic lapses and a significant amount of under and/or misreporting, but the long-time series accumulated still represents one of the best records of conch harvest in the Caribbean (Appeldoorn 1991). Table 2 and Figure 4 depict the total and the queen conch landings between 1983-2000 given in C/S reports. Figure 5c shows estimates of the queen conch landings since 1967 obtained from different sources. During the first half of the 1970's the fishery was fairly stable, yielding roughly 70,000 lbs per year. The late 1970's and early 1980's were marked by a dramatic

increase in landings, attaining the maximum yield ever of 400,000 lbs in 1983. Increases in production during this period have been attributed to an increase in the number of fishermen, an increase in the use of scuba diving for harvesting, and to fishing further offshore, in deeper waters, and in previously unexploited areas (Appeldoorn 1991). Between 1984 and 1992 a marked decline in landings was observed, reaching the lowest level in the time-series of 100,000 lbs. The causes of this decline may include population declines as a result of the use of SCUBA, increase in market value, and a decrease in the rate of catch reported by fishers (García-Moliner, 1997). Since 1993, the fishery appears to have experienced another increase in yield, attaining 29,000 lbs in the year 2000. The causes of this increase are yet to be determined, but may have to do with increased effort and improved reporting over these years.

Recreational landings statistics are not collected in Puerto Rico. A survey of the recreational fishery in Puerto Rico (Appeldoorn and Valdez-Pizzini 1996) suggested that conch fishing was a minor component, with only 11% of the fishers taking conch besides other fish and shellfish species.

4.3 Regulations

Conch regulations including size and weight limits were first established in 1984 for the island of St. Croix. A continued decline in landings for St. Thomas/St. John resulted in a 5-year moratorium on harvest from 15 February 1988 to 31 December 1992. The closure was continued for an additional two years to allow the stocks to recover. St. Croix was not included in the moratorium. Heavy fishing pressure following the reopening of the fishery on April 1994 resulted in the establishment of unified regulations for the U.S. Virgin Islands. They were amended on 12 July 1994 to include the following (CFMC 1996;García-Moliner 1997; CFMC/CFRAMP 1999):

- 1) Annual closed season: July 1st– September 30th.
- 2) Landing restriction:
 - Must be landed whole and in the shell.
 - No disposal of shell at sea prior to landing.
- 3) Minimum size: Min. 23 cm (9 inch) in shell length or at least 9.5 mm (3/8 inch) in lip thickness.
- 4) Harvest quota:
 - a. Commercial harvest limit of 150 conch per day per licensed fisherman.
 - b. Recreational bag limit of 6 per person per day or 24 per boat.
- 5) Sale restriction: No sale of undersized conch shell

No territorial regulations for queen conch are in place in Puerto Rico.

The marine resources in federal waters of the U.S. Caribbean are regulated by the Caribbean Fishery Management Council (CFMC) under the Magnuson Act. Federal waters are those extending beyond the 3 and 9 nautical miles territorial seas of the U.S.V.I. and Puerto Rico, respectively. In January, 1997 the CFMC implemented a

Fishery Management Plan (FMP) for the Queen Conch Resources of Puerto Rico and the U.S. Virgin Islands. The regulations in the FMP are basically the same as in the U.S.V.I., for the federal waters of the U.S. Caribbean (CFMC, 1996; García-Moliner 1997):

- 1) Prohibit the possession of undersized conch defined as less than 9 inches (22.9 cm) total length (as measured from the tip of the spire to the distal end of the shell) or with less than a 3/8-inch (9.5 mm) lip-thickness measured at the thickest point of the lip. All species in the fisheries management unit must be landed still attached to the shell.
- 2) Prohibit the sale of undersized queen conch and queen conch shells as defined.
- 3) Establish a bag limit for personal-use fishers of 3 queen conch per day, not to exceed 12 per boat; licensed commercial fishers may land 150 queen conch per day for the first year. The commercial fishers' quota will be lowered to 100 queen conch for the second year and to 75 the third year. The quota reduction is subject to review upon receipt of empirical information on which to base the decisions for new limits.
- 4) All conch harvested under these provisions must conform to minimum size specifications and be landed still attached to the shell.
- 5) Establish an annual closed harvest season from July 1st through September 30th for queen conch.
- 6) Prohibit the harvest of queen conch in the exclusive economic zone (EEZ) using hookah gear. Any person with queen conch and hookah gear aboard a vessel in the EEZ will be presumed in violation of this prohibition.

5. SUMMARY OF THE QUEEN CONCH INFORMATION FROM THE U.S. CARIBBEAN AVAILABLE AT THE SEFSC/ NMFS AND USEFUL FOR STOCK ASSESSMENT

The SEFSC has geared significant effort and resources toward obtaining relevant biological and fishery information of past and ongoing fisheries research from the U.S. Caribbean. Most of the information on queen conch (*Strombus gigas*) has been retrieved and reviewed and is now available for assessment at the Miami Laboratory. It includes reports, publications and data sets from various agencies, institutions and investigators around the U.S. Caribbean, mainly: the Caribbean Fishery Management Council (CFMC), the Department of Planning and Natural Resources, Division of Fish and Wildlife of the U.S. Virgin Islands (DFW), the Department of Natural and Environmental Resources, Fishery Research Laboratory of Puerto Rico (FRL/DNER), the University of Puerto Rico, and the Pascagoula and Miami Labs/SEFSC/NMFS. The information relevant for stock assessment can be classified as follows:

1. Surveys
 - a. SEAMAP-C and other fishery-independent abundance surveys.
 - b. Biostatistical port-sampling surveys.
 - c. Surveys for estimation of effort and CPUE from commercial and recreational fishers.

2. Commercial fisheries information
 - a. Landing statistics.
 - b. Fishermen lists (i.e., fishing licenses, fishermen id's, vessel numbers, etc.)
 - c. Trip Interview Program (TIP).
3. Other research
 - a. Growth and biostatistic studies
 - b. Stock assessments

The specific studies included under 'Surveys' and 'Commercial fisheries information' are outlined in Table 3. The main results from the growth studies conducted to date in the U.S. Caribbean are given in Table 4, and those from abundance/density surveys and previous assessments are presented in Tables 3, 5, and 6. Note that most data from these growth and stock assessment studies are not available at the Miami Lab, but estimated parameters and indices will have significant use in future assessments, particularly the growth equations, abundance indices, and MSY values.

6. ANALYSIS OF BIOMETRIC DATA

Biometric data from Rivera (1999) and Tobias (1987) were reanalyzed using standard linear and non-linear regression to establish improved relationships between shell dimensions and weights and to assess the variance around them. Queen conch grow in shell length until they reach sexual maturity, subsequent growth is in the form of shell-thickening. Shell-length has thus been used to assess growth in the juvenile phase and shell-lip thickness to assess growth in the adult phase (Appeldoorn 1988, 1990).

Size frequency distributions and mean statistics for the conchs surveyed in 1999 (Rivera 1999) in Puerto Rico, St. Thomas-St. John, and St. Croix are shown in Figure 6 and Table 7. Regression parameters are provided in Table 8, and Figures 7 and 8 illustrate the morphometric relationships among the variables of interest (shell length/lip-thickness on total weight, tissue weight and dressed meat weight). All relationships were analyzed by island, but tests for differences among islands and between sexes (i.e., analyses of covariance) were not performed.

Size-frequency distributions and regression results for the conchs surveyed in St. Croix in July 1986 (Tobias 1987) are presented in Figures 9-11 and Tables 9 and 10.

Power functions of the form $Length = A * Weight^B$ provided the best fits for shell-length and weight comparisons, whereas linear functions best described shell-lip-thickness and weight relationships, as well as meat weight on total weight. Note that lip-thickness functions have large intercept values, which indicate the weight of conchs attained in the juvenile phase. To estimate the weight gained as adults, the juvenile weight (or a mean value of juvenile weight per island) should be subtracted from the equation (see Appeldoorn 1988, 1992b). Also, these relationships gave the poorest fits (particularly the meat weight vs. lip-thickness), presumably because the animal's tissue growth is limited after maturity and because the cleaning process used to obtain the meat (filet) adds a large amount of variability to the estimated meat weight.

7. SUMMARY OF THE LANDINGS STATISTICS FOR THE COMMERCIAL QUEEN CONCH FISHERIES OF THE U.S. CARIBBEAN

The commercial landings statistics of the fishery resources of Puerto Rico and the U.S. Virgin Islands are now the focus of the U.S. Caribbean research conducted at the Miami Lab/SEFSC, as they will constitute the basis for stock assessments.

Mandatory reporting programs for commercial fisheries data were established in 1967 and 1974 in Puerto Rico and the U.S. Virgin Islands, respectively. Since then, they have been among the leaders in documenting total landings and detailed statistics on catch, effort, and other characteristics of the conch fishery on a continuing basis. However, the programs have had several periodic lapses, significant under and/or misreporting, and changes in the type of data collected. In addition to these (relatively common) flaws in the data collection process, computarization of the information has not been consistent, with entire years not being digitized. Finally, the transfer of the electronic data-sets among the various agencies involved (NMFS, DPNR/DFW, DNR/FRL) has also been inconsistent, resulting in incomplete or redundant files.

Despite the problems noted above, Puerto Rico and the U.S. Virgin Islands have accumulated long time-series that represent some of the best records of conch harvest in the Caribbean (Appeldoorn 1991), perhaps only surpassed by the Turks and Caicos fishing records.

The Miami Lab has undertaken the task of compiling, reviewing, and analyzing the existing information for the fishery resources of Puerto Rico and the U.S. Virgin Islands, including queen conch. In the last two years (2000-2001), due to improved collaboration among the Labs and agencies involved in the Cooperative Statistics Programs, almost the entire commercial landings data sets (at the trip-ticket level) have been reassembled and currently reside at the Miami Lab.

At the present time, a few gaps, errors and duplicates persist, but the data is undergoing major organization, standardization, editing, and quality control that should provide with solid information in due time. Then, formal stock assessments of the fishery resources of Puerto Rico and the U.S.V.I. will be feasible.

The summaries and descriptive analyses that follow were performed based on the best available information up to year 2001. Therefore, they should be considered preliminary and subject to change, according to expected updates and amendments to the original data sets.

7.1. UNITED STATES VIRGIN ISLANDS

7.1.1. Description of the Data

In 1974, U.S. Virgin Islands Legislative Act 3330 established a mandatory reporting system for fisheries data. To improve the information (total landings by gear type), the U.S. Virgin Islands Division of Fish and Wildlife, Bureau of Fisheries (DPNR/DFW) and NMFS entered into a cooperative agreement in 1983 to obtain more detailed data.

Landings data in the U.S. Virgin Islands are collected directly by fishermen. They mail or deliver monthly reports to the DFW. All reports for the 12-month period beginning in July must be received before a commercial fishing license is renewed. DFW is responsible for entering the data and verifying it prior to submission, once a year, to the SEFSC. DFW maintains separate data sets for the landings made in St. Croix and the landings made in St. Thomas and St. John combined. Computerization of the data began in 1982 for St. Thomas/St. John and in 1983 in St. Croix (Poffenberger 2000a, 2000b).

Up to December 2001, landings statistics were available from July 1986 through December 1999. During this period, DFW changed the monthly reporting form three times to accommodate the level of detail necessary to assess and manage this complex fishery. Maps of the U.S. Virgin Islands and the different catch report forms are provided in Appendix A.

Catch records from 1986-1992 report the landings (in pounds) per trip by category (bait fish, fin fish, lobsters, conch, whelk and others), gear type (hook and line, net, pot/tripe and dive), and area fished. In consequence, landings statistics are not available by species for the bait and finfish categories. During some years (between 1986-99) the forms contained a separate field for each type of gear (short form), whereas in other years there was a single column for the fish code, another for the gear type and a third for the total catch. The latter files are labeled LOGB87_8, USVI_88 through 92, or contain the suffix VI_O, STX__OLD.

In 1993 the structure of the catch report form changed to include landings of tuna, dorado, and wahoo. This form was used from 1993-1996.

In the 1994-1995 fishing year the St. Croix office introduced a new form, which requested fishermen to report: catches of family or species groups (instead of the broad categories of fin fish that were used previously); to provide an estimate of fishing effort (the number of gear and the estimated time in hours fished during the trip); and the distance from shore (i.e., less than 3 miles, 3 to 200 miles or greater than 200 miles). The fishing area designations and gear categories remain the same. The New form (or long form) was tested by a small group of fishermen on a volunteer basis in the 1994-1995 and 1995-1996 fishing years. Its use was expanded to the entire territory in 1996.

For a long time, fishers continued to report landings data on outdated catch report forms, which resulted in the production of two or three data files for a fishing year. Accompanying each generation of catch forms were new gear and location codes (a summary, taken from Bolden 2001, is provided in Appendix A). Because of these landings reports, the data could not be stored in the NMFS Accumulated Landings database, and until the end of 2001, the data were available in separate data sets for each

calendar year on the local area network maintained by the SEFSC. The data sets for St. Croix and St. Thomas-St. John have been combined by year (Cummings 1997, Bolden 2001, Poffenberger 2000 a, 2000b).

The most apparent flaws in the current data sets include (but are not limited to) the following: the data set for 1996 only contains six months of data (July-December); fishing years 1992-1993 and 1997/1998 for St. Croix are incomplete or missing and may need updating; fishing year 1995 forward for St. Thomas-St. John may need to be re-edited and replaced (N. Cummings, pers com.); and, in general, coding errors, typos, duplicates, and other editing problems. DFW and SEFSC personnel are leading the re-editing process.

7.1.2. Approach

Queen conch landings statistics are contained in the general landings database of the U.S. Virgin Islands. Thus, it was necessary to manipulate the whole data set in order to extract the relevant information for this (queen conch) study. Landings data were provided as separate files by fishing year from 1996-97 to 1998-99. In some cases, landings for all islands were contained in single (yearly) files; in other cases, landings from St. Thomas-St. Johns were included in one file for a particular year, and landings from St. Croix in a separate one. Extensive manipulation of the data sets was required to build a single database, given that the format and content of the records varied so much through time. The SAS software version 8.0 (The SAS Institute 2000) was used to filter the data.

The aim was to assemble a single data set with one record per trip to be able to draw time-series of catch and effort by island. The following steps summarize the process used to combine, merge, and analyze the 1986-1999 landings data of the U.S. Virgin Islands:

1. Data sets for years with similar or consistent formats were combined into a single data set, resulting in three distinct data sets. Data sets from all islands/ areas were combined. At this stage all the fields (columns) were maintained, even when some may have been incomplete or empty as changes in the format occurred. The 3 data sets were:

- i. One with the old (short) format, where the landings were collected by gear type (the files in this category are labeled with the prefix LOG_ ,LOGB_ , SHOR_).
- ii. The second format is similar to the previous one, but the landings are given by species group. It contains the fish codes in one column, the gear codes in another and the landings in a single third column (the files included are labeled VI_ O, USVI_ , STX__OLD). Records from this file were later split by fish code in order to have the landings of each fish type on a separate column as above and one record per trip.
- iii. Includes files in the New (or Long) format, with landings reported by species. The files included have labels with the suffix _R, _N, or _NEW.

2. Edition of these combined data sets included cleansing errors and removing duplicates and outliers. It is important to note that coding and typing errors were corrected to the extent possible, based on the lists of codes and reports available. Some of the filters imposed:

- Errors in the identification codes or the vessel numbers could not be corrected because the fishermen lists were not available at the moment.
- Duplicate records were considered those where all the fields were equal.
- Only records with obvious outliers in the landings, zero landings or no date were removed.
- Records where all the fields but the landings were equal were grouped (merged) into a single record, by adding up the landings and keeping the rest of the fields intact.
- Records without an identification code or vessel number were assumed to correspond to one trip per record.
- An island field was assigned when missing, according to the area landed.
- To preserve as much information as possible, some summaries had to be drawn from these three separate files, particularly those concerning the fisheries as a whole (i.e., catch composition, fishing areas, gears used, time spent fishing, etc).

3. A single data set was constructed by matching up as much information from the different forms as possible. Some fields were renamed and codes standardized for consistency; other fields were summarized and others discarded if necessary. Unfortunately, most of the details associated with each individual trip were lost in the process due to format incompatibility. In particular, all effort information (i.e. the type and number of gear used to capture each species or group, the hours fished), the area fished, the distance from shore and the species composition were discarded.

In this combined (and summarized) data set the queen conch landings were separated from the other species, and the total landings (all species pooled) were calculated. The new fields included were: trip date, year, month, identification/boat number, island, and landings (conch, other species and total). This allowed the estimation of total effort (in number of trips) and the corresponding catch by island by the time period selected. Also, the proportion of the total trips and the total catch represented by the conch fishery was estimated.

4. A subset containing only trips with conch catch (“conch-positive trips”) was drawn from the previous data set. This allowed the estimation of catch and effort in the directed and non-directed (incidental) sectors of the queen conch fishery. Nominal catch per unit effort was estimated from the directed fishery.

It is evident that the criteria used in this editing and merging process may be somewhat subjective and arbitrary. However, the approach was consistent throughout the study and may be reproduced, so that any biases in the estimates may be traced. Furthermore, this study intends to provide rough approximations of fishery statistics that will be refined once the official editing of the data is completed.

7.1.3. Results

It is important to emphasize that the present study was based on the best information available up to the end of year 2001. Nonetheless, gaps in the information, coding errors, duplicates and other flaws in the data collection, recording, and editing systems may still be present in the results that follow. Thus, they should be used with caution and only to illustrate general trends.

1. General Information on the Commercial Landings Statistics of the U.S. Virgin Islands

Annual landings of the multispecies and multigear fishery of the U.S. Virgin Islands appear to have increased from 1986 to 1991 to a maximum of 3 million pounds in 1991 (see Table 11 and Figure 12). A subsequent decline occurred in 1992, with fairly stable landings since then, fluctuating around 1 to 1.2 million pounds. The same general pattern was observed when the total catch was divided by island. Such trends in the landings appeared somewhat correlated to the fishing effort exerted, evaluated here as the total number of fishing trips by year.

Further exploration of the total landings from the U.S. Virgin Islands between 1986 and 1999 indicated that 64% corresponds to the islands of St. Thomas/St. John and the remaining 36% to St. Croix (Table 12, Figure 13). Queen conch represented roughly a two percent of the total landings of the USVI, with a 5% of the landings in St. Croix and a 0.4% in St. Thomas/St. John.

As explained before (in the Approach Section 7.1.2.), different information was available according to the format of the original catch reports, and therefore there is data on certain aspects of the fishery for some years, and on certain other aspects for other years, with occasional overlaps.

To summarize the landings statistics from the USVI, it was necessary to separate them by the format in which they were originally reported. Therefore, in the present study the species composition of this combined, multi-species fishery is given either by species (NEW-Long format), species-group (USVI format) or gear-type (OLD-Short format). Figure 14 illustrates the catch composition by island group, both as a proportion of the total catch and as a proportion of the number of trips in which each species/group/gear was present. The species most represented were parrotfish, snappers and lobsters; the groups, reef fish and finfish; and the gear-categories, potfish, hookfish and netfish. Queen conch landings had a small representation in all categories, but were always present, particularly in St. Croix.

The same procedure described above was used to determine which species were associated to queen conch in the positive conch trips. In general, dived lobsters, parrotfishes, snappers and groupers (speared and potted) were the species groups most frequently represented in the catch (see Figures 15 a,b,c). The presence of each species varied between islands depending on whether the proportion of trips or of the total catch was considered, and on the trip-ticket format (Figure 15d). From these figures, it appears that the conch fishery in St. Croix is more directed because it showed a greater representation (% of total weight) and fewer species were associated with conch trips.

Nevertheless, it is important to consider that in this study “conch-positive” were trips where conch was present in any amount (conch landings >0 lb), so the target may not necessarily have been conch. For further analyses, it would be important to establish a break point that defines a “conch-targeted trip”, for example, a trip that landed more than twenty pounds of queen conch. This will be done once the database is filtered and re-edited. For this study, “conch-targeted”, “conch-directed” or “conch-only” will be a trip where exclusively conch was captured.

As observed in Figure 16, the gears used most frequently in positive queen conch trips were scuba and free diving (88%) in conch-directed trips and scuba (89%) in trips that harvested conch and other species. The mean number of gear (number of divers) in scuba trips was 3.5; with a mean of 1.6 divers in conch-only trips and 2.3 divers in trips where other species were caught. The mean number of traps hauled was close to 20 traps in non-directed trips and 8 in directed trips. However, note that traps captured conchs in less than 1% of the trips. The mean number of hours spent fishing in all conch trips (directed and not) fluctuated around 5 hrs for those years that contained this information (1996-1999).

Landings records by fishing area are provided in Table 13 and Figure 17. The results showed that the largest proportion of the total landings came from undefined areas, both in St. Thomas/St. John and St. Croix (areas TTT and XXX). The same applies to conch landings. Other areas reporting significant conch trips/landings were area T2 in St. Thomas/St. John and areas XSE, XNE, and C4 that correspond to the east portion of St. Croix (see map of the U.S.V.I. in Appendix A). The mean annual landings and the mean number of trips by fishing area were proportional to the total landings.

2. Summary of the Commercial Queen Conch Landings Statistics of the U.S. Virgin Islands.

Between years 1986-1999 queen conch represented 18 % of the combined landings in conch-positive trips (>0 lb conch) in St. Thomas/St. John and 36% in St. Croix. From the total number of conch-positive trips carried out in the USVI during this period, 84% landed in St. Croix, with 88 % of the total queen conch catch. This information is provided in Table 14 and Figure 18.

Total conch trips in the USVI seem to have increased since 1991, although with large fluctuations. A clear pattern was not evident in the total conch landings by year, as several fluctuations appeared across the time series. These patterns (or the lack thereof) may reflect the fact that the data set is still incomplete, and that the fishery was closed in St. Thomas/ St. John between 1988 and 1992. Also, from these figures, it appears that most of the conch fishery occurs in St. Croix.

Figure 19 represents the total and the queen conch landings and fishing effort (number of conch-positive trips) by island from 1986 to 1999. For both territories, the number of conch-positive trips appeared more correlated to the conch catch rather than to the combined (multi-species) catch, which suggests that, in fact, conch-positive trips target conch and harvest other species incidentally. Again, it would be worthwhile to establish a limit to define a conch trip (e.g., > 10-20 lb of conch) and observe the pattern.

Large fluctuations were observed in the St. Thomas/St. John queen conch catch-effort time-series (Figure 19), but an overall declining trend was apparent since 1987, when conch landings reached 10,700 pounds with 180 trips. In 1999, the effort exerted was near 110 trips and the catch only 2,000 pounds. At the beginning of the time-series, there was a close association between catch and effort, but in recent years it was not so clear, when apparently about half of the landings were obtained with similar levels of effort.

The queen conch catch-effort time-series from St. Croix has also experienced large fluctuations since 1987, but the general trends seem to be increasing. In 1998 a total of 44,100 pounds were landed in 760 trips. A tight relationship was observed between the number of trips and the weight landed.

In an effort to find seasonal patterns in the queen conch landings throughout the year, the data from years 1986-1998 was averaged by month (Table 15, Figure 20). The landings (queen conch and other associated species) and the number of trips seem to remain fairly stable between January and June, then decrease dramatically during the summer months (seasonal closure) and rise again toward the end of the year. These trends apply to both island groups. The effort (number of trips) applied right after the closure is noticeably larger than before the closure, then it stabilizes. The opposite trend was observed in the nominal queen conch catch rates by month, which seem to increase in July-August. These rates may suggest a larger abundance of the species in the fishing grounds during the warm summer season (particularly in St. Croix) and/ or that fishers try to catch more conch in fewer trips during the closure. Nominal catch rates by month were larger in St. Croix than in St. Thomas, with mean values of 62 lb/trip and 41 lb/trip, respectively.

Nominal catch rates (by positive trip) for queen conch in the USVI were calculated as the weight landed in pounds by fishing trip (lb/trip). Nominal catch rates by year are provided in Table 16 and are depicted in Figure 21. A peak in the CPUEs was observed for both islands in 1988, near 100 lb/trip, and a smooth decline since then. The fishery was closed in St. Thomas/ St. John 1988-92, so there is limited or no information for those years (particularly 1991-92), but data from the following years (1993 on) suggested fairly stable rates, with a value of 23 lb/trip in 1999. Year 1999 was not available for St. Croix at the time of this study, but the CPUEs since 1993 also remained fairly stable until 1998, near 60 lb/trip. Both islands showed the lowest rates in 1992. Again, for St. Thomas/St. John this low value may represent illegal fishing during the closure.

The nominal queen conch catch rates plotted against effort (Figure 21b) allowed further examination of the trends through time. In fact, no clear pattern was observed for the St. Thomas/St. Croix fishery, as levels of CPUE and effort could not be associated to any sequential period of time. In general, data from the 1990's showed much lower CPUEs than in the 1980's, averaging 30 and 72 lb/trip, respectively. However, the amount of effort to attain such (low) levels did not necessarily increase through time. These results are probably inconclusive, and may reflect either large gaps in the database, misreporting or simply poor data, as it is unlikely that catch and effort levels can change so dramatically from one year to the next.

The scenario for the queen conch fishery in St. Croix was quite different (Figure 21b). The catch rates versus effort did show a trend, a downward slope through time. In the 1980's, catch rates were between 70-100 lb/trip (average=83 lb/trip) with the lowest effort levels observed (around 180 trips in 1988-90). Through the 1990's, catch rates averaged 57 lb/trip and the effort increased from 130 trips in 1990 to 760 in 1998. This could be a sign of overfishing and stock decline.

Standardized catch rates were not calculated for two main reasons: it was difficult to combine data sets (with different formats) that contained distinct information, and once combined, very little information (i.e., regression factors) regarding individual trips could be preserved. At best, only the year, season (month), island and perhaps fishing area and target information (e.g. licensed conch fishermen) may be used for standardization once the data sets are filtered and updated.

3. Summary Statistics for the Directed/Non-Directed Sectors of the Queen Conch Fishery in the U.S. Virgin Islands.

The trends in the catch rates presented in the previous section included information retrieved from all queen conch (or conch-positive) trips. In this section, these data were divided into the trips that targeted conch exclusively (directed sector of the fishery) and those that did not (non-directed sector) in order to assess the differences in the catch rates and to establish the criteria needed for further analyses.

As observed in Table 17 and Figure 22, in St. Thomas/St. John the proportion of the directed conch fishery varied considerably across the time series (between 0% and 95%), but in general was very low (with a mean of 9% of all conch-positive trips), except for years 1993-94, when this proportion reached 95%. These were the years immediately following the 4-year closure (1988-1992), so this figure suggests a strong shift in effort to the directed sector of the fishery. During the years of the closure, no trips that targeted conch exclusively were observed.

The trend in the catch distribution from St. Thomas/St. John follows closely that of the effort distribution, both for the directed and non-directed sectors of the conch fishery. A single peak in the catch/effort distribution is not evident, as various fluctuations were observed through time. Major declines in the landings may reflect either the closure of the fishery (1988-1992), gaps in the data set, or declines in abundance. In the nominal catch rate distribution a peak is observed in 1988 for the non-directed sector, followed by the closure, and low levels thereafter. A large positive effect resulting from the closure (increased abundance) is not clear from this analysis. In years where both modes were present (1993-99), the average nominal catch rates were slightly larger in the directed sector (34 lb/trip vs 27 lb/trip). The variance was greater for the non-directed sector, perhaps because conch capture is relatively incidental and opportunistic.

In St. Croix there were no trips that targeted conch exclusively from 1987 to 1992, but from 1993 through 1998 most trips did, ranging from 44% to 88% of the total conch-positive trips, depending on the year (Table 17 and Figure 22). The mean proportion of the directed sector in years when both modes were present (1993-1998) was 64%. The catch and effort distribution appear correlated in both sectors, with several

fluctuations across the time series. The nominal catch rates for both sectors in those years were larger for the directed sector (average of 56 lb/trip vs. 48 lb/trip). In both cases the catch rates remained near those levels since 1993, after an overall decline between 1988 and 1992. Note that the fishery was not closed during those years in St. Croix, only in St. Thomas/St John. At the end of the time series, the catch rates from the directed fishery showed a slight increase, which was corroborated with preliminary information for years 1999-2001.

4. Estimation of “Full-Time” Conch Fishermen in the US Virgin Islands from the Commercial Landings Database

No independent fishing license information was available at the time of this study. Given that such information may prove useful to define the directed and non-directed sectors of the queen conch fishery and to standardize catch rates, a proxy of the number of fishermen that targeted conch exclusively between years 1986-1999 was drawn from the commercial landings statistics. The estimates are shown in Table 18. Conch fishermen were classified as “full-time” (fishing conch exclusively) and “part-time” (fishing conch plus other species) and the data was aggregated for all years. A “full-time” fisherman was defined as an identification number that targeted conch exclusively during one or more years.

Overall proportions are illustrated in Figure 24. This approach may overestimate/underestimate the actual number of conch fishermen and of full-time/part time fishermen because the data were combined for all years and because some fishermen may have entered or left the fishery or switched between sectors over that period of time. The proportions per year were also estimated (Figure 23) by classifying the fishermen on a yearly basis. St. Thomas/St. John had the smallest number of conch fishermen and St. Croix the largest, with approximately 66% of them being “full-time”. However, in St. Croix full-time fishers were only present from 1993 onward.

7.1.4. Summary. U.S. Virgin Islands

The preliminary results provided in this section showed that queen conch represented only 2% of the total landings in the U.S. Virgin Islands from 1986-1999. The conch fishery is concentrated around St. Croix (over 90% of the landings), particularly in the eastern part of the island. Around 36% of the conch landings corresponded to the targeted sector in St. Croix, and 18% in St. Thomas/St. John. Scuba and free diving were the main methods used to harvest conch.

Total conch landings fluctuated significantly during the period 1986-1999, never exceeding 45,000 pounds. No clear trends could be established for the whole fishery but when sorted by island, landings from St. Croix did show a decreasing trend since 1992, and in 1997-98 they were under 60,000 pounds. The dataset for St. Thomas/St. John was very inconsistent and no clear conclusions could be drawn from it, except that landings generally appeared to be below 10,000 pounds and in 1999 they increased dramatically to over 100,000 pounds. Fishing effort levels in both islands also showed heavy fluctuations, with an increasing trend since the beginning of the time-series. Catch rates

suggested downward slopes in both island groups, resulting both from reduced landings and from much larger effort exerted in recent years, particularly in St. Croix.

Some seasonal patterns were observed in both island groups. Catch rates were fairly constant from January to June, increased during the summer closure (even when total landings obviously declined significantly) and then remained at higher levels toward the end of the year. Analysis of the catch composition showed that lobsters, parrotfish, snappers, groupers and triggerfish were the species groups most frequently represented in positive conch trips. The proportion of conch fishermen from all fishermen was 2.5% in St. Thomas/St. John and 19.5% in St. Croix, from which 54% and 66% were estimated as “full-time” conch fishermen, respectively.

The data from St. Thomas/St. John available to date was sparse and inconclusive, and no further analyses should be made until more (and better) information becomes available. Alternatively, the analyses from St. Croix did suggest that fishing may be affecting the conch stock, judging from the decreasing trends in the landings and catch rates and the rising effort levels. A formal assessment of the fishery using an updated dataset is recommended to corroborate this perception.

7.2. PUERTO RICO

7.2.1. Description of the Data

The Fisheries Research Laboratory (FRL) of the Puerto Rico Department of Natural and Environmental Resources (DNER) monitors the commercial landings of fish and shellfish in Puerto Rico. The Fisheries Statistics Program (FSP) was implemented in 1967 under the Commercial Fisheries Research and Development Act of 1964 (PL 88-309) to collect data on the commercial fishery. Currently, this project is supported by NOAA/National Marine Fisheries Service (NMFS) through the State/Federal Cooperative Fisheries Statistics Program (S/F), Interjurisdictional Fisheries Programs (IJ) and the DNER.

The objective of the Puerto Rico/NMFS program (S/F) is to maintain reporting services on the commercial finfish and shellfish resources of Puerto Rico, as well as to manage and disseminate the fisheries statistics through coordination of activities between NMFS and the FRL/DNER. This includes processing and summarizing the monthly landings. Computerized raw data is submitted on a yearly basis to the SEFSC/NMFS. The main goals of the S/F program are: 1) to collect landings data from the island of Puerto Rico ensuring coverage of all coastal municipalities and their major fishing centers; 2) to determine the total weight and ex-vessel value of the principal finfish and shellfish landed in PR each month; 3) to manage, correct, evaluate, summarize data and prepare reports; 4) to collect biostatistical data; and 5) to collect data to estimate catch per unit effort (CPUE) from landings and from biostatistical data (Matos-Caraballo 2001).

Commercial fishery data are collected from voluntary fishers, fish buyers and fishing associations from around Puerto Rico. Port agents (4 at the moment) and the program's principal investigator have historically visited the 42 coastal municipalities including the islands of Vieques and Culebra, and the 88 identified fishing centers (see map of Puerto Rico in Appendix B). Data are collected using a landing trip ticket system (provided in Appendix B), which has been consistent since the program's inception (Matos-Caraballo 2001).

The following data are collected with the trip tickets: fishing date, name of fish buyer, fisherman and/or helper, fishing license number, municipality, fishing center (landing area), number of trips reported, gear type, fishing effort (hours fishing), weight in pounds by species or taxonomic family, market value, depth, and fishing area. Tickets use common names and species identification is possible using Erdman's (1985) numeric codes. Fishermen usually land fishes, lobster, oyster and octopus in the round (not eviscerated); conch weights include (dressed) meat only.

Frequently, fishers report more than one trip in a single ticket, which complicates analysis. For estimation of CPUE, the DNER uses only those tickets that clearly indicate a single trip. In addition, the DNER has traditionally used a correction factor in the calculations to correct for under-reporting. This factor is expressed as the percentage of fishers that regularly cooperated with statistics, divided by the total number of active fishers in the island (see Table 2).

The landings statistics for this study include years 1986-2000, which became available -at the trip-ticket level- by the Fall of 2001. No major gaps in these data have

been detected, and the file format has been very consistent, so the estimates presented here should be fairly reliable. The database, however, is still undergoing quality control at the DNER in coordination with the SEFSC. The final (official re-edited) version will be finished promptly. Independent edits were made for the present study, based on the best information available by the end of 2001. No other commercial or recreational data was available at the time of this study. In particular, fishermen license files have not been located.

7.2.2. Approach

As in the U.S. Virgin Islands, the commercial landings statistics from Puerto Rico keep record of a complex multi-gear and multispecies fishery, of which queen conch is only one of the nearly 425 species of fish and shellfish landed each year. To summarize all this information and extract the queen conch component, it was necessary to manipulate and edit the data to some extent. The goal was to create a single data set with one trip-ticket per record to ultimately obtain time series of catch and effort and other fishery statistics. The SAS software version 8.0 (The SAS Institute 2000) was used to process the data.

The major problem faced when reorganizing the database was that in the electronic files one record does not represent one trip ticket. Apparently, each species landed is entered as a separate record with the corresponding trip information. Therefore several records may represent a single trip, or conversely, information from each trip-ticket may be repeated several times, according to the number of species landed. Reorganizing and summarizing this information was cumbersome and several assumptions had to be made.

The method used to reorganize, summarize, and analyze the landings data from Puerto Rico was the following:

- i. A single data set was assembled from the separate 1983-2000 files available. Individual records contained catch information by species landed, resulting in several records per trip. The fields included were: date, center, identification code, number of trips, type and amount of gear, species, total weight landed, price, and hours fishing. The correction of coding errors and outliers, and the elimination of duplicate and zero catch records were made at this stage.
- ii. The new data set was split by species, resulting in a file with 437 columns (approx. 420 species plus the trip-specific information). This file was summarized by estimating the total catch, the conch catch and the non-conch catch (sum of all other species' catch). General information from the multi-species fishery was extracted at this point because most of the original fields, containing detailed information, were still present. However, some errors also persisted (duplicates, missing or incorrect information).
- iii. Further reorganization consisted in grouping the records under the assumption that each date + identification code + fishing center (county and coast) combination represented one trip. Records with different fishing area code but all other fields equal were considered duplicates, under the assumption that

the same vessel could not have landed the same catch (in composition and weight) in a different location on the same date.

This file structure merged the catch of different species under the same trip. However, other specific information was lost, such as the gear used, the hours fished, the port landed, etc., since they sometimes differed by species. It was assumed that after this step each new (grouped) record would correspond to one trip-ticket, with information for one or more trips. (62% of the trip tickets reported one trip and 99.5 % between 0-20 trips).

- iv. To perform the conch analyses, a subset of the previous data set was created by selecting the records (trip-tickets) with positive conch landings (7.8% of the total).
- v. As noted above, the trip-tickets from Puerto Rico include information regarding the number of trips being reported. Ideally, each fisher should report every trip separately, but this is not always the case and other problems then arise in the analysis. It is impossible to distinguish which and how many of the trips targeted one or other species and the effort exerted by species. This complicates the estimation of fishing effort and catch rates when single species assessments are intended, so only records that reported single trips were used for this purpose.
- vi. A final data set (and the queen conch subset) that contained only records reporting single trips was created. One final assumption was needed to account for records reporting unknown, zero or blank number of trips: the records with NUM_TRIPS =1, 0, ?, or blank were assumed to correspond to one trip. In the raw data set, 61.7% of the total 485,687 records reported one trip; after correcting, 81% of the records became single-trip.

A similar proportion of one-trip records was observed in the raw queen conch landings data subset (61.5% of 37,963 records). After eliminating the records with multiple trips and correcting the number of trips=1, the conch landings in the final data set used in single-trip analyses, contains 81.3% of the total conch landings in the 1983-2000 database.

The general approach used in this section was to analyze the queen conch fishery of Puerto Rico as a component of a complex multi-gear and multi-species fishery. The analyses were divided into: 1) the general landing statistics of the combined multi-species fishery that included all the fishing trips and landings reported; and 2) the single-trip statistics that included only single-trip records, used for the estimation of catch rates of the multi-species fishery and of the queen conch fishery.

7.2.3 Results.

1. General Information on the Commercial Multispecies Fishery of Puerto Rico (based on all the landings records, including multiple-trip records)

It is important to consider that the procedures used in this study to reorganize, clean and summarize the original data may not have followed the standard criteria of the

Fisheries Statistics Division. In consequence, the estimates that follow are only approximations based on the best information available by the end of year 2001 and the author's best judgment to re-edit the data.

The total number of trip-tickets collected in Puerto Rico between 1983 and 2000 was estimated to be approximately 485,700, with 7.8% reporting queen conch. The number of trip-tickets collected each year is given in Table 19 and Figure 25a.

Annual landings of the multispecies fishery of Puerto Rico appear to have undergone at least two major fluctuations during the period 1983-2000, as illustrated in Table 20 and Figure 25b. A decline was observed from 1983 to 1988 (to a minimum of 2 million pounds), followed by fairly stable landings until 1993, a subsequent increase peaking in 1998 with 4 million pounds, and a small decline in the last three years. The same general pattern was observed in the effort distribution, calculated as the total number of fishing trips by year. Queen conch represented a 7.2% of the total landings of Puerto Rico during that period, as illustrated in Figure 25c.

In an effort to find seasonal patterns in the combined landings throughout the year, the data from years 1983-2000 were averaged by month, as presented in Table 21 and Figure 26. Both, the landings of queen conch and other species and the amount of effort exerted (number of trips), appear to remain fairly stable throughout the year, with a slight decline toward the last quarter.

Figure 27 represents the trends in mean annual catch rates for the whole time series (1983-2000) and by month. Estimates are provided in Table 22. Only nominal CPUEs for the combined multispecies fishery are shown because the number of trips by species (particularly queen conch) could not be sorted from the records that reported more than one trip.

Using all the catch records, a very stable trend in the nominal catch rates was observed throughout the time series, with a mean catch rate of 80 lb/trip for all the species combined. A small peak was observed in years 1986-87 at approximately 125 lb/trip. The catch rates calculated using only single-trip records were slightly larger, with a mean value of 101 lb/trip and a peak at around 200 lb/trip in 1986. This difference between catch rates may be a result of over-reporting the number of trips in multiple-trip records. No clear seasonal trends in the nominal, multispecies CPUEs were observed in either case.

Regional trends in the landings statistics from Puerto Rico are presented in Table 23 and Figure 28, as fractions of the total landings and trips by municipality (county) and coast between 1983-2000. Municipality codes are given in Appendix B. The West coast of Puerto Rico alone contributed with nearly 45% of the total landings and 32% of the fishing trips. The Cabo Rojo municipality was particularly productive, contributing with approximately 29% of the total catch. The same trends apply to the queen conch landings, with Cabo Rojo providing a 54% of the total conch yield.

The nominal catch rates by region estimated with all catch records (provided in Table 24 and Figure 29) suggested that the largest CPUEs occurred in the West Coast, with an average of 106 lb of combined landings by trip. The municipality of Cabo Rojo showed an average rate of 140 lb/trip, and was followed by Luquillo in the North Coast

with 128 lb/trip and by Rincón, also in the West Coast with 119 lb/trip. The marked differences in catch rates observed among municipalities may be useful for future catch rate standardization.

The composition of the multispecies fishery of Puerto Rico indicates that silk snapper, spiny lobster and queen conch were the three most common species landed between years 1983-2000 (Table 25, Figure 30). Queen conch represented a 7.25% of the total landings during this period.

The main gears used in the multispecies fishery of Puerto Rico are illustrated in Table 26 and Figure 31. Fish pots, bottom lines and scuba diving are represented in about 33%, 26% and 14% of all the fishing trips conducted between years 1983-2000.

2. Information on the Commercial Queen Conch Fishery of Puerto Rico (based on single-trip records).

Estimates obtained using only single-trip records (Table 27) indicated that queen conch represented a 6.5 % of the combined landings from Puerto Rico between 1983-2000, and positive conch trips (≥ 0.5 lb conch) represented a 7.6 % of all fishing trips during that period. Only 26 % of these trips involved the directed sector of the queen conch fishery, which corresponded to 1.8% of the combined landings and 28% of the total conch volume landed. These overall proportions are illustrated in Figure 32. The relative proportions by year and the catch-effort time-series are shown in Figure 33.

There have been some fluctuations in conch landings and in the amount of effort exerted between 1983-2000 (Figure 33d). Average conch landings during this period have been 120,000 pounds per year and the average effort exerted has been around 1,500 trips per year. Two peaks in the landings were observed in the time-series, one in 1988 and a second one in year 2000, both with approximately 220,000 pounds landed. The lowest level of 72,000 pounds was obtained in 1992. Since then, there has been an upward trend in the conch landings. The effort estimated from all the positive conch trips has shown marked fluctuations through time, reaching the highest level in 1995-1996 with approximately 2,650 conch-positive trips/year. Effort then declined in 1997-1999, but a sharp increase from 1,500 to 2,500 trips was observed again in year 2000, which suggests a rising trend in the current effort levels.

The correlation between the total conch landings and the positive conch trips (Figure 33d.) was not as tight as when the trips were broken down into the two distinct sectors of the fishery: directed (conch-only) and non-directed (conch plus other species), as seen in Table 28 and Figure 34. As expected, this relationship was proportional for the directed (conch-only) sector, whereas for the non-directed sector there was no clear association between conch landings and effort. This may indicate that conch capture is relatively incidental in this case, although 72% of the total conch landings come from this sector of the fishery. The non-directed sector showed larger fluctuations both in the landings and in the effort exerted, with average values of 86,300 pounds and 1,125 trips per year, respectively. The directed fishery appeared far more stable, particularly since 1989, with average landings of 33,270 pounds per year and an average of 391 directed trips per year. Note however that only about 30% of the total conch landings result from targeted trips.

Mean monthly trends in the landings statistics from Puerto Rico were calculated for years 1983-2000 in order to explore seasonal patterns in the conch fishery. A relative peak in the volume landed and in the number of conch trips is observed from March to May, and the fishery appears at its lowest level in September. This trend is consistent with the conch landings estimated from all the trips reported (see Table 29 and Figure 35).

As observed in Table 30 and Figure 36, the gears most frequently used in the Puerto Rican conch fishery between 1983-2000 were scuba diving (82%), followed by spear fishing (8.4%) and skin diving (5 %).

As far as the economic value of the conch fishery is concerned, the value per pound increased steadily from an average of \$1.33 per pound in 1993 to \$2.00/lb in 1990, and has remained fairly stable since then, with an average of \$2.30/lb in year 2000 (Table 31, Figure 37).

The catch composition in positive queen conch trips was assessed in order to explore patterns of species associations that might be relevant for the estimation of targeted effort and standardized conch catch rates. Patterns were established in terms of the proportion of conch-positive trips where a particular species was present and of the proportion of the volume landed that corresponded to that species. Results are provided in Table 32. Spiny lobster was present in 62 % of the conch fishing trips and, in terms of the volume landed, queen conch represented 56% and spiny lobster 12% of the total weight. Several other species were associated with conch trips in smaller proportions, as illustrated in Figure 38.

3. Nominal Catch Rates (based on single-trip records)

Nominal catch rates for the combined multispecies fishery and for the queen conch fishery of Puerto Rico were estimated as the weight landed in pounds by fishing trip (lb/trip). Estimates are provided in Tables 33 and 34 and depicted in Figure 39. The conch fishery followed the signals of the combined fishery very closely, with the highest rates observed in 1986-1987 (approx. 200 lb/trip for the combined fishery and 165 lb/trip for the conch fishery). Clear declines in all catch rates were observed in 1988, to approximately 95 lb/trip, with relatively constant rates thereafter. Another slight increase in the conch CPUE was observed in 1998 (~107 lb/trip), and a current level of 93 lb/trip (in year 2000).

In general, after 1987 the catch rates of the multispecies fishery did not show any evident signals. This may stem from the fact that all the species' landings, gears, and trips were lumped into a single unit and averaged over a whole year. Therefore, these estimates are rather uninformative and inconclusive. The pattern may change if finer species groups are defined or catch rates are analyzed by species. However, this is beyond the scope of the present study.

Nominal catch rates for queen conch were broken down into the two sectors of the fishery (Figure 39b). Given that around 75% of the positive conch trips were non-directed (as observed in Figure 32), this sector followed the trend of all the positive conch trips very closely, with a peak in 1986-1987 (~170 lb/trip), and a mean value of 71lb/trip since

1988. In contrast, nominal catch rates from the directed sector showed a less prominent peak in 1986-1987 at 135 lb/trip, but were generally greater than those from the non-directed sector, with average rates of 78 lb/trip since 1988. All conch catch rates have remained fairly stable since 1988, and may be increasing slowly since 1998. The current trend cannot be confirmed until the data is updated for years 2001 and 2002.

Whether the conch fishery is analyzed as a whole or by sector, the largest contrast in the catch rates was observed near the beginning of the time-series. Since 1988, the signals have been weak, and no marked increases or declines have been observed. Then, it would appear that the fishery is in a steady state or, if catch rates are interpreted as indices of abundance, that population levels may seem stable. But, if Figure 39c is examined closely, the amount of effort used to obtain relatively constant catch levels (averaging 85 lb/trip) has increased about 25 times since the early 1980's. In 1984, 92 trips were made to attain an average of 88 lb/trip, whereas in year 2000, around 2,400 trips were needed to attain a similar catch rate (93 lb/trip). The worst scenario was observed in 1996, when almost 2,650 trips were made to get an average of only 50 lb/trip. Such sharp increases in the amount of effort exerted may be a sign that the fishery is indeed declining or overfished, as stated in most other conch studies.

Average catch rates by month for all the species combined suggested relatively constant rates throughout the year, except for a peak in July and slightly larger values toward the end of the year (see Table 35 and Figure 40a). Overall queen conch catch rates (for all conch-positive trips) followed the same trend, but the peak in July was very clear (approx. 130 lb/trip) and CPUE values thereafter did not seem to increase. Average conch catch rates during the first half of the year fluctuated around 80 lb/trip and around 90 lb/trip during the second half.

Conch catch rates from the directed sector were fairly stable throughout the year, while the non-directed sector showed larger fluctuations, particularly in the summer months, with a maximum of 130 lb/trip in July. This sector guided the overall conch CPUE trend. The average rates of both sectors were very similar throughout the year (around 87 lb/trip), but CPUEs of the non-directed sector appeared slightly larger during the second semester.

In an effort to establish further patterns in the CPUE series, catch rates were estimated by municipality (county) and coast (north, east, south, west) for all years (1983-2000) combined. These are presented in Table 36 and Figures 41 and 42. No major differences were observed between the CPUEs obtained using all the data and those obtained using only one-trip records. Both, for all the species combined and for queen conch, the largest catch rates were observed in the West Coast of Puerto Rico, with an average of 113 and 93 lb/trip, respectively.

The conch CPUEs by municipality (Figure 42b) showed that the largest values correspond to Ponce (Code 32) in the South Coast (163 lb/trip), Fajardo (Code 18), East Coast (124 lb/trip), Arecibo (Code 5) and Luquillo (Code 17) in the North Coast (124 and 113 lb/trip). There was no apparent correlation between these catch rates and the total landings reported by municipality, as seen previously in Figure 28, where the largest volume reported was for Cabo Rojo (Code 37) in the West Coast. Nonetheless, both, the

largest volumes of conch landed and the largest conch catch rates over the period 1983-2000 were observed in the West Coast of Puerto Rico.

Catch rates were not standardized for this study because the data set is currently under revision. Once it is clean and updated, standardization will be possible by using the reduced dataset (single-trip records only). Results from the present study showed that the factors that may be useful for further analyses are: year (a time-series of CPUEs is desired), season of the year (or month), municipality/ coast, and target information (e.g., directed/non-directed sectors or full-time/ part-time fishermen).

4. Estimation of “Full-Time” Conch Fishermen in Puerto Rico from the Commercial Landings Database

No independent fishing license information was available for this study. Given that such information may prove useful to better define the directed and non-directed sectors of the fishery and to standardize catch rates, a proxy of the number of fishermen that targeted conch exclusively between years 1983-2000 was drawn from the commercial landings reports. Conch fishermen were identified as “full-time” (harvest conch only) and “part-time” (harvest conch plus other species) for each reported trip. The data were summarized by year by counting the number of fishermen that targeted conch exclusively during the year and those that reported other species in addition to conch. This approach may overestimate the actual number of conch fishermen because some may not have been exclusively full-time/part time on every trip they made during the year, so they may have been counted twice, as “full-time” and as “part-time”, depending on the trip. In addition, some fishermen may have entered or left the fishery over the year. More refined analyses can be made by doing monthly counts of the number of fishermen and by matching landings reports with fishing license information.

The average proportion of conch fishermen from all fishermen between 1983-2000 was 16.2 % and the “full-time” conch fishermen were 6.5% of the total (Table 37 and Figure 43a). The total number of fishermen fluctuated over that period, reaching a peak in 1996-1997, with approximately 2,370 fishers. In year 2,000, a total of 1,979 fishers were estimated. A census conducted in 1995-96 (Matos-Caraballo 1996) estimated a total of 1,758 active fishermen, so the approach used here may be overestimating the actual number.

From the conch fishermen, an average of 40% were “full-time” (Figure 43b). The largest number of conch fishermen was observed in 1996, with 417 reporting conch in at least one trip and 180 fishing conch “full-time”. In year 2000, 352 fishermen reported conch at least once and 143 reported only conch. Rivera (1999) estimated a total of 209 conch fishermen, so the present “full-time” estimate is within reasonable bounds. However, an alternative definition of a conch fisherman may be needed to obtain better results (i.e., conch fisherman= harvest \geq 20lb conch/trip). All the information presented here needs to be corroborated with fishing license information, once it becomes available.

7.2.4. Summary. Puerto Rico.

These preliminary analyses showed that queen conch represents a 7% of the combined multi-species landings from Puerto Rico. Since 1983, queen conch landings have been below 400,000 pounds per year, with a major decline between 1990-1992 to almost 100,000 pounds. Since then, landings have increased steadily, to a level of nearly 300,000 pounds in year 2000. The amount of effort targeted to the queen conch fishery could not be calculated from multiple-trip records, but the total number of trips also increased significantly since 1990. Nominal queen conch catch rates calculated from single-trip records suggested relatively constant rates, averaging 80 lb/trip since 1988. These observations could be interpreted as signs of stock decline. No clear seasonal patterns were observed, which imply that the fishery operates on a year-round basis.

The queen conch fishery is mostly concentrated on the West coast of Puerto Rico; the municipality of Cabo Rojo alone, contributed with 54% of the total conch landings between 1983-2000. The data suggested that the directed sector constitutes a very small proportion of the conch fishery (2%). Analysis of the catch composition showed that lobsters, snappers, hogfish and octopus are associated to queen conch trips. Scuba diving is the method most used to harvest conch. A 16% of all fishermen were conch fishermen and only 6.5% were “full-time”.

At this point, fluctuating landings, sharp increases in effort and declining trends in the catch rates suggest that overfishing of the queen conch stocks may indeed be happening in Puerto Rico. Whether they are in an overfished condition remains to be examined in future analyses, as much as establishing control rules relative to stock status.

8. GENERAL CONCLUSIONS

In this study the queen conch fisheries of Puerto Rico and the U. S. Virgin Islands were presented within the context of the larger, more complex multi-species fisheries that have historically guided their overall behavior and performance. At the same time, a major endeavor was to isolate conch-specific information (landings, effort, targeting information, full-time fishermen, etc.) such that single-species assessments could be made. The results presented here thus summarize the main aspects of the combined multi-species fisheries of the U.S Caribbean and provide significant insight into the queen conch fisheries. They also set the grounds to guide future analyses.

The main contribution of this study, however, may be that most of the queen conch information that was previously scattered has now been compiled, reviewed and analyzed. There appear to be sufficient data to conduct formal stock assessments in the near future, as soon as the official filtered and updated data sets for Puerto Rico and the U.S. Virgin Islands are released.

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John Poffenberger and Nancie Cummings contributed enormously with their personal knowledge of the U.S. Caribbean fisheries and the landings databases. They and Josh Bennett kindly provided the original landings datafiles, data updates, and historic

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TABLES

Fishing Year	Registered Fishermen	Reporting Fishermen	% Fishermen Reporting	Reported Landings	Projected Landings	Catch Rates (Catch/fisher/yr)
1980-1981	421	162	38.5%	475060	1188784	2933
1981-1982	578	216	37.4%	712812	1832623	3300
1982-1983	454	223	49.1%	633204	1275006	2840
1983-1984	437	288	65.9%	881812	1365540	3062
1984-1985	437	319	73.0%	857557	1209411	2688
1985-1986	536	276	51.5%	930682	1892464	3372
1986-1987	529	223	42.2%	784186	1866947	3517
1987-1988	523	244	46.7%	622232	1382358	2550
1988-1989	425	288	67.8%	1077878	1583613	3743
1989-1990	404	190	47.0%	633361	1318204	334
1990-1991	370	224	60.5%	1021734	1702462	4561
1991-1992	428	276	64.5%	1116262	1731190	4044
1992-1993	409	356	87.0%	1100028	1260162	3090
1993-1994	474	337	71.1%	1409188	2022800	3090
1994-1995	396	351	88.6%	1361542	1567486	4182
1995-1996	362	324	89.5%	960194	1095861	3879
1996-1997	343	334	97%	1257879	1308525	2964
1997-1998	369	346	93%	1444307	1607506	3766
1998-1999	342	336	96%	1191453	1239729	4174

Table 1. U.S. Virgin Islands commercial landings statistics (Fishing Years 1980-1981 to 1998-1999). Total projected landings are based on the proportion of reporting fishermen * total reported landings. Catch rates are reported landings/reporting fishermen. Source: Annual Reports of the Cooperative Fishery Statistics Program (DFW/DPNR 1984-2000).

Year	Total Landings	Correction Factor	Number of Trip tickets	Conch Landings
1983	3,929,608	61%	31,316	437,436
1984	3,155,385	N/A	18,682	344,737
1985	2,839,361	56%	16,261	325,543
1986	2,666,925	N/A	18,175	200,286
1987	2,094,580	88%	18,129	151,654
1988	2,075,569	56%	18,953	238,727
1989	2,305,004	56%	19,969	160,588
1990	2,186,435	N/A	21,770	108,075
1991	2,463,017	N/A	27,234	108,157
1992	2,044,207	60%	24,218	90,947
1993	2,509,441	64%	25,303	165,136
1994	2,714,402	64%	23,882	170,720
1995	3,708,999	71%	39,141	215,488
1996	3,617,039	71%	38,280	242,720
1997	3,895,980	78%	38,470	238,887
1998	3,501,898	78%	32,839	260,753
1999	3,337,486	78%	35,545	214,288
2000	3,362,722	71%	38,887	287,228

Table 2. Puerto Rico commercial landings statistics (1983-2000). Reported total and queen conch landings are included, and the total trip-tickets collected. The correction factor is the percentage of fishers that regularly cooperated with statistics, divided by the total number of active fishers. N/A= information not available. Sources: Annual Reports of the Cooperative Fishery Statistics Program (FRL/DNER 1984-2001).

1. SURVEYS					
	a. ABUNDANCE SURVEYS		b. BIOSTATISTICAL SURVEYS		c. EFFORT AND CPUE SURVEYS
TERRITORY	Data	Reports	Data	Reports	Data and Reports
PUERTO RICO	1. SEAMAP-C (April 1996)	1. Appeldoorn, R.S. 1996. Underwater survey of the queen conch resource in Puerto Rico. CIAF No.9566.	1. Biostatistical data from port sampling survey (Rivera, 1999)	1. Rivera, J.A. 1999. Queen conch CPUE assessment in PR & USVI: preliminary report. SEFSC/NMFS.	1. Rosario, A. 1995. Queen Conch Stratification Survey. Seamap-Caribbean Project CFMC/NMFS. 33p.
	2. Data N/A	2. Rosario, A. 1995. Queen Conch Stratification Survey. Seamap-Caribbean Project CFMC/NMFS. 33p.	2. Data N/A	2. Appeldoorn, R.S. 1992. Development of a combined model of growth in weight... Proc.Gulf Carib. Fish. Inst. 42 (A):13-20.	(Data N/A) 2. Rivera, J.A. 1999. Queen conch CPUE assessment in PR & USVI: preliminary report. SEFSC/NMFS. 3. Appeldoorn, R.S. and Valdez-Pizzini, M. 1996. Survey of recreational fishing in Puerto Rico, with emphasis on queen conch. UPR/ CFMC. (Data N/A)
U.S. VIRGIN ISLANDS	1. SEAMAP-C (August 1996)	1. Friedlander, A.M. 1997. Status of queen conch populations around the northern USVI with management recommendations for the Virgin Islands National Park Report for the USGS, St. John, USVI. 40 p.	1. Biostatistical data from CFMC Conch Project (1986)	1. Tobias, W. 1987. Biostatistical data on commercially harvested queen conch from the insular shelf around St. Croix, USVI. Technical Report, CFMC.	(Same as above)
	2. Data N/A (FY 1985 and 1990)	2. Friedlander, A. M. et al. 1992. Spatial and Temporal variations in stock abundance of queen conch, <i>S. gigas</i> , in the U.S.V.I. In: Apeldoorn & Rodriguez (Eds.), 1992.	2. Biostatistical Data N/A (FY1994, 1995, 1998)	2. Tobias, W., 1999. U.S.V.I. Stock Assessment. In: Belize Report, CFMC, 1999. p.p.57-75.	
	3. Abundance data- (1981)	3. Wood, R. and D.A. Olsen. 1983. Application of Biological Knowledge to the Management of the Virgin Islands Conch Fishery. Proc. Gulf Carib. Fish. Inst. 38:370-375.			

2. COMMERCIAL FISHERIES INFORMATION		
	a. COMMERCIAL LANDINGS	
TERRITORY	Data	Reports
PUERTO RICO	1. Trip-ticket data (1983-2000) (Landings by coast and municipality) 2. TIP Program Length/weight samples (33 observations) (11/1998- 3/1999)	1. Summary Reports FY 1992-2001 Cooperative Fishery Statistics Program, DNER/NMFS, Puerto Rico
U.S. VIRGIN ISLANDS	1. Trip-ticket data (1986-1999) Landings by island (St. Thomas-St. John, St. Croix) and fishing area. 2. Fishermen Lists STT/SJ - 1995-2002 STX -1999-2001	1. Summary Reports FY 1984-2000 Cooperative Fishery Statistics Program, DFW/NMFS, U.S.Virgin Islands

Table 3. Information reviewed and available for assessment at the Miami Lab on the queen conch resources of Puerto Rico and the U.S. Virgin Islands.
**Shaded areas indicate data that is not yet resident at the SEFSC.

JUVENILES		Growth Equation			Morphometric Relationships				
Reference	Location	von Bertalanffy $L_t=L_{\infty}(1-e^{-k(t-t_0)})$							
		L_{∞} (mm)	k (yr^{-1})	t_0 (yr)	Tot Wt-Len	Shell Wt-Len	Tissue Wt-Len	Meat Wt-Len	Meat Wt-TotWt
Berg, 1976	St. Croix, USVI	241.7	0.42	---	Log TW=1.003+0.102 L			Log MW= -0.045+ 0.109 L	Log MW=-1.052+1.043 LogTW
	St. John	260.4	0.516	---					
Wood and Olsen 1983	U.S.V.I.	260	0.515	---	TW=0.0164 L ^{3.713}				MW= 6.465+ 0.077 TW
Tobias 1987	St. Croix, USVI				TW = -1719.7+14.208 L	SW = -1296.35+10.939 L		MW = -354.76+2.962 L	MW= 39.517+ 0.185 TW
Appeldoorn 1988, 1990	La Parguera, PR (JUVENILES)	340 460	0.437 0.25	0.462 0.244		Log SW=-1.786+3.517 Log L	Log TiW=-2.286+3.459 Log L	Log MW=-2.535+3.486 Log L	
Appeldoorn 1988	La Parguera, PR (ADULTS-Lip Thickness)	54.9	0.3706	---					
Rivera 1999	Puerto Rico St. Croix, USVI St. Thomas/St.John,USVI				TW=-1414.9+158.17 L TW=-866.43+143.17 L TW=-708.95+220.71 L				

Reference	Location	JUVENILES-ADULTS	ADULTS
		Growth Equation	Morphometric Relationships
Wood and Olsen, 1983	U.S.V.I.	Gompertz	TotW-Lip TW = 885 Lip ^{0.256}
		N/A	
Appeldoorn 1988, 1992	La Parguera, PR	Meat Wt-Age MW= 4.394E-07 e ^{20.12(1-e(-1.275 t))} Tissue Wt-Age TiW= 1.263E-05 e ^{17.44(1-e(-1.126 t))}	MeatW-Lip Log(MW+100)= 1.797+0.232 Log (Lip) TissueW-Lip Log (TiW+100) = 1.764 + 0.403 Log (Lip) Shell Wt-Lip Log(SW+1000)= 2.793+0.293 Log (Lip)

Table 4. Reported growth equations and morphometric relationships for juvenile and adult *Strombus gigas* in the U.S. Caribbean. Shell length (Len) is used for juvenile functions, lip-thickness (lip) is used for adult functions. Length and lip-thickness are in millimeters, weight is in grams, and time is in years. The sources of all functions are provided.

Population and Fishery Parameters for the U.S. Virgin Islands							
Source	Wood and Olsen 1983			Appeldoorn 1992			Tobias 1999
Parameter	USVI	St. Croix	St. T-St. J.	USVI	St. Croix	St. T-St. J.	St. Croix
Assessment yrs	1967-1981			1967-1981			1993-1998
M (1-2yrs)	0.115			0.85			
F	0.67-1.685				0.245	0.49	
Z	0.22-1.42			1.34			
Density		7.6 conch/ha	9.7 conch/ha		26 conch/ha	33.8 conch/ha	
Shelf Area		34,300 ha	162,925 ha				
Standing Stock		260,680 conchs	1,580,372 conchs				
Adult Biomass					83,243.8 g		
Recruits		324,340	1,966,313		900,000	5,500,000	
YPR		80 g/recruit			30 g/recruit	30 g/recruit	
MSY (1967-1981)		60,000 lb/yr	364,000 lb/yr		27,216 kg/yr	164,656 kg/yr	35,102 lb/yr
Yield/ha		2.09 kg/ha	2.69 kg/ha		.785 kg/ha	1.01 kg/ha	

Table 5. Population and fishery parameter estimates from stock-production and yield-per-recruit assessments of the queen conch fisheries of the U.S. Virgin Islands. Appeldoorn (1992) reanalyzed the data (1967-1981) from Wood and Olsen's (1983) assessment; Tobias' (1999) assessment for the CFMC/CFRAMP included fishing years 1993-1994 to 1997-1998 for St. Croix only.

MSY and Density Estimates by Island/Coast							
Source	Year/Estimate	PR West	PR East		PR South	St. Croix	St. Thomas-St. John
	Assessment years	1971-1986	1978-1984	1985-1991	1978-1984	1967-1981	1967-1981
Appeldoorn 1991, 1992	Density (kg/ha)	0.553	0.23	0.503	0.33	0.571	0.571
	MSY (kg)- (Adjusted)	226,800	40,824	90,720	40,824	19,504	92,988
	MSY (lb)	500,000				42,000	200,000

Table 6. Appeldoorn's (1991, 1992) adjusted density estimates, stock-production model and yield-per-recruit results for the West Coast of Puerto Rico. His YPR estimates for the U.S.V.I. are also shown. Estimates for the East and South coasts of Puerto Rico were based on the yield levels observed between 1978-1984.

BIOMETRY OF FEMALES BY ISLAND

P. R.	LENGTH (cm)	LIP (cm)	TOT. WGT. (g)	UNCLEAN (g)	CLEAN (g)
Mean	24.26	1.56	2420.13	405.87	291.95
Std. Err.	0.18	0.08	41.36	6.90	7.94
N	278	278	278	260	204
St. Croix	LENGTH (cm)	LIP (cm)	TOT. WGT. (g)	UNCLEAN (g)	CLEAN (g)
Mean	24.08	1.97	2628.99	491.42	351.09
Std. Err.	0.22	0.09	57.40	13.77	9.08
N	69	69	69	67	69
St. Thomas	LENGTH (cm)	LIP (cm)	TOT. WGT. (g)	UNCLEAN (g)	CLEAN (g)
Mean	21.02	1.83	3841.17	401.86	297.17
Std. Err.	0.16	0.09	90.21	31.10	26.26
N	93	93	93	93	93

BIOMETRY OF MALES BY ISLAND

P. R.	LENGTH (cm)	LIP (cm)	TOT. WGT. (g)	UNCLEAN (g)	CLEAN (g)
Mean	23.72	1.47	2341.39	370.04	298.43
Std. Err.	0.22	0.06	45.12	7.81	8.70
N	218	217	218	226	136
St. Croix	LENGTH (cm)	LIP (cm)	TOT. WGT. (g)	UNCLEAN (g)	CLEAN (g)
Mean	24.18	1.91	2544.23	479.23	343.08
Std. Err.	0.25	0.10	57.75	11.95	10.01
N	65	65	65	65	65
St. Thomas	LENGTH (cm)	LIP (cm)	TOT. WGT. (g)	UNCLEAN (g)	CLEAN (g)
Mean	20.65	2.24	3926.88	327.31	266.80
Std. Err.	0.18	0.06	67.70	27.41	23.91
N	107	107	107	107	107

Table 7. Biometry of female and male queen conchs by island. Mean and variance values for shell length, shell lip-thickness, total weight, unclean (tissue) weight, and clean (dressed) meat are given. (Taken from Rivera 1999).

Weight Variable	Island	N	Shell Length= A* (Weight Variable) ^B			95 % CL	
			Parameter	Estimate	StdErr	Lower CL	Upper CL
Total Wt	PR	465	A	13.87	3.99	8.00	23.73
			B	1.62	0.09	1.45	1.79
	STT/STJ	201	A	115.61	57.42	51.61	259.87
			B	1.16	0.16	0.89	1.42
	STX	134	A	125.41	82.43	45.93	354.78
			B	0.95	0.21	0.62	1.26
Tissue Wt	PR	421	A	7.37	3.06	3.27	16.42
			B	1.25	0.13	1.00	1.51
	STT/STJ	129	A	3.95	2.87	0.97	16.39
			B	1.63	0.24	1.17	2.09
	STX	132	A	8.03	4.81	2.67	25.33
			B	1.29	0.19	0.93	1.63
Dressed Meat Wt	PR	341	A	1.38	1.01	0.33	5.72
			B	1.66	0.22	1.22	2.11
	STT/STJ	120	A	1.99	1.62	0.41	9.82
			B	1.80	0.27	1.28	2.32
	STX	134	A	6.16	3.89	2.33	16.91
			B	1.27	0.20	0.95	1.57

Table 8. Shell-length-weight relationships for queen conch by island. Parameters for power functions of the form Length= A* Weight^B are provided. Data source: CFMC/ Rivera (1999).

Shell Length= A* (Weight Variable) ^B				
Total Weight vs Length		95% CI		
N=	300			
Parameter Estimate	ApproxStd	Lower CL	Upper CL	
A	0.020	0.014	0.005	0.079
B	2.066	0.128	1.817	2.313
Undressed MW vs Length				
N=	73			
Parameter Estimate	ApproxStdErr			
A	0.006	0.009		
B	2.053	0.306		
Tissue W vs Length				
N=	291			
Parameter Estimate	ApproxStd	Lower CL	Upper CL	
A	0.0004	0.0004	0.0001	0.003
B	2.507	0.187	2.148	2.865
Meat Weight vs Length				
N=	300			
Parameter Estimate	ApproxStd	Lower CL	Upper CL	
A	0.004	0.003	0.001	0.020
B	2.059	0.142	1.782	2.335

Table 9. Shell-length-weight relationships for queen conch in St. Croix. Parameters for power functions of the form Length= A* Weight^B are provided. Data source: CFMC Conch Project/Tobias (1986).

Linear Fits		WEIGHT= A+B (Lip-thickness)			
Variable	N	R ²	Param.	Estimate	s.e.
Total Wt	299	0.43	A	1144.02	31.32
			B	72.34	4.82
Meat Wt	299	0.24	A	258.21	8.03
			B	12.05	1.24
		MEAT WT= A+ B (TOTAL WT)			
Meat Wt vs	300	0.69	A	39.50	11.34
Total Wt			B	0.18	0.01

Table 10. Linear functions fit to describe lip-thickness-weight and meat- total weight relationships for queen conch in St. Croix. Data source: CFMC Conch Project/Tobias (1986).

YEAR	BOTH ISLANDS		ST THOMAS/ST.JOHN		ST CROIX	
	TotCatch	TotTrips	Catch,T	Trips,T	Catch,X	Trips,X
1986	459608	6206	459608	6206		
1987	409646.8	5736	404266.8	5710	5380	26
1988	67264.5	201	8249	16	59015.5	185
1989	346004	4316	110279	1313	235725	3003
1990	961100.1	6505	568490.6	2937	392609.5	3568
1991	2961301	12788	1827817	6074	1133484	6714
1992	1738724.2	10996	1029891	7132	708833.2	3864
1993	1105441	12136	786840	7247	318601	4889
1994	1290753	14789	717787	6501	572966	8288
1995	1017690.4	9988	663348.6	5222	354341.8	4766
1996	1056691.3	10004	631432	4470	425259.3	5534
1997	1240676.8	13485	715704.8	5346	524972	8139
1998	1228890.3	11178	862026	4821	366864.3	6357
1999	815842	5673	606275	2662	209567	3011

Table 11. Total estimated landings and number of trips for the combined multispecies fishery of the U.S. Virgin Islands (1986-1999).

YEAR	Total Number of Trips		Total, T	Total, X	Other Spp, T	Other Spp, X
	Conch, T	Conch, X				
1985	0	0	2	0	2	0
1986	119	0	6206	0	6157	0
1987	182	26	5710	26	5677	26
1988	14	185	16	185	16	185
1989	2	188	1313	3003	1313	3003
1990	0	130	2937	3568	2937	3568
1991	0	487	6074	6714	6074	6714
1992	2	344	7132	3864	7132	3864
1993	130	255	7247	4889	7126	4738
1994	55	662	6501	8288	6449	7800
1995	46	513	5222	4766	5213	4315
1996	95	273	4470	5534	4467	5414
1997	69	687	5346	8139	5342	7727
1998	36	763	4821	6357	4821	5899
1999	106	0	2662	3011	2659	3011
Total	856	4513	65657	58344	65383	56264

YEAR	Total Landings		Total, T	Total, X	Other Spp, T	Other Spp, X
	Conch, T	Conch, X				
1985			25		25	
1986	6842		459608	5380	452766	3217
1987	10715	2163	404266.8	5380	393551.8	41115.5
1988	1420	17900	8249	59015.5	6829	41115.5
1989	100	13041	110279	235725	110179	222684
1990		10283	568490.6	392609.5	568490.6	382326.5
1991		36161	1827817	1133484	1827817	1097323
1992	25	16037	1029891	708833.2	1029866	692796.2
1993	5417	14005	786840	318601	781423	304596
1994	1889	33876	717787	572966	715898	539090
1995	1443	23918	663348.6	354341.8	661905.6	330423.8
1996	2601	13670	631432	425259.3	628831	411589.3
1997	1672	38409	715704.8	524972	714032.8	486563
1998	876	44114.5	862026	366864.3	861150	322749.8
1999	2522		606275	209567	603753	209567
Total	35522	263577.5	9392014.8	5307618.6	9356492.8	5044041.1

Table 12. Estimated total, queen conch and other species landings and number of trips by island in the U.S. Virgin Islands (1986-1999). T= St.Thomas/St. John, X=St.Croix.

ISLE	FISHAREA	Trips-CONCH	s.e.	Catch-CONCH	s.e.	Trips-OtherSpp	s.e.	Catch Other Spp	s.e.
T	BBB					114.0	23.9	35171.3	9602.1
	JN					2.0		348.0	
	JS					10.0		1848.0	
	T2	60.5	32.5	3347.5	1927.5	60.5	32.5	16197.4	9480.4
	TNE					324.8	134.7	63116.2	34168.6
	TNW					174.5	66.0	37421.0	17588.2
	TSE					593.8	210.0	112427.3	51858.3
	TSW					487.8	153.3	108406.9	53287.4
	TTT	0.4	0.4	100.0		1487.6	551.9	344390.7	184233.3
X	C1	1.0	1.0	135.0		20.0	3.0	1141.0	531.0
	C2					135.5	56.5	10376.5	4749.5
	C3					15.5	10.5	1491.5	672.5
	C4	26.0	10.0	2060.0	1120.0	246.0	3.0	25278.0	4762.0
	C5	1.0		45.0	15.0	73.0	10.0	4683.0	641.0
	XCX					1.0		145.0	
	XN	1.5	0.5	77.5	17.5	11.5	0.5	791.5	425.5
	XNE	29.6	4.7	1710.2	451.3	564.6	256.5	73664.0	34085.2
	XNW	0.3	0.3	85.0		110.0	46.6	13010.5	7736.5
	XS					130.5	1.5	10109.5	1855.5
	XSE	35.5	31.6	3956.7	3510.1	448.0	131.4	62715.1	22731.5
	XSW	5.3	2.1	186.3	32.0	623.8	206.5	76644.8	35163.0
	XXW					1.0		120.0	
	XXX	173.5	49.6	11670.0	3083.0	1714.8	580.5	226561.4	93870.8
	ZZZ					37.5	35.5	3576.5	2768.5
?					3		142		

Table 13. Estimated mean annual landings and mean number of fishing trips by island and area for years 1986-1999. Queen conchs were separated from all other species. Trips-conch are trips where conch was present; Trips-Other species are trips where conch was not present T= StThomas/StJohn X=StCroix. Area codes are given in **Appendix A**

St. Thomas/St. John		LANDINGS			
YEAR	Num Trips, T	CONCH, T	OTHER SPP, T	TOTAL, T	
1986	119	6842	4105	10947	
1987	182	10715	29033.75	39748.75	
1988	14	1420	6717	8137	
1989	2	100	280	380	
1990					
1991					
1992	2	25	92	117	
1993	130	5417	254	5671	
1994	55	1889	140	2029	
1995	46	1443	2165	3608	
1996	95	2601	6541	9142	
1997	69	1672	4311	5983	
1998	36	876	10248	11124	
1999	106	2522	100398	102920	
Total	856	35522		199806.75	

St. Croix		LANDINGS			
YEAR	Num Trips, X	CONCH, X	OTHER SPP, X	TOTAL, X	
1986					
1987	26	2163	3217	5380	
1988	185	17900	41115.5	59015.5	
1989	188	13041	47802	60843	
1990	130	10283	60585	70868	
1991	487	36161	135029	171190	
1992	344	16037	121772.5	137809.5	
1993	255	14005	5242	19247	
1994	662	33876	9272	43148	
1995	513	23918	3458	27376	
1996	272	13650	12395.5	26045.5	
1997	687	38409	16451	54860	
1998	763	44114.5	10833	54947.5	
Total	4512	263557.5	467172.5	730730	

Table 14. U.S. Virgin Islands (1986-1999). Estimated queen conch and other species landings and number of trips by island in positive queen conch trips. T= St. Thomas/St. John, X=St. Croix.

(a)

ISLE	MONTH	Mean TRIPS		LANDINGS					
		s.e.		Mean Conch	s.e.	Mean Other Spp	s.e.	Mean Total	s.e.
T	1	12.00	3.51	521.25	161.43	4614.88	3451.10	5136.13	3522.59
	2	10.71	1.85	356.86	81.65	2948.86	2540.36	3305.71	2556.15
	3	9.33	3.24	358.00	174.89	3263.00	2974.63	3621.00	3022.88
	4	17.40	4.20	633.80	261.86	5870.40	5300.79	6504.20	5304.52
	5	10.50	1.44	377.00	101.84	468.00	187.74	845.00	228.87
	6	7.29	1.77	226.86	65.81	672.29	343.20	899.14	401.44
	7	24.00	5.13	1251.00	367.37	2429.33	2060.31	3680.33	1712.10
	8	19.25	7.17	1021.50	379.73	1528.25	1256.69	2549.75	1359.01
	9	10.75	3.33	487.75	198.61	780.75	567.16	1268.50	732.55
	10	12.50	1.26	502.00	118.41	606.83	197.25	1108.83	273.60
	11	8.75	1.77	372.00	107.76	652.59	283.11	1024.59	363.11
	12	12.00	1.69	512.71	171.22	2291.57	1250.01	2804.29	1254.81
X	1	54.56	13.51	3156.89	766.48	5814.45	2528.94	8971.34	2611.72
	2	53.22	12.41	3244.56	708.94	6102.22	1889.34	9346.78	1867.58
	3	52.60	13.68	2931.20	775.77	5858.67	2619.02	8789.87	2968.99
	4	51.22	13.06	2661.89	598.17	5442.66	2390.56	8104.54	2576.01
	5	50.89	13.73	2810.61	828.27	6145.80	2985.83	8956.41	3458.23
	6	45.50	14.32	2560.70	883.41	4594.77	2183.88	7155.47	2302.53
	7	6.33	2.46	560.17	239.36	1229.33	385.49	1789.50	599.96
	8	6.50	1.74	446.13	153.84	1875.31	859.52	2321.44	1000.07
	9	8.88	3.55	589.50	325.34	1570.50	857.88	2160.00	1176.63
	10	66.22	16.98	4245.44	1191.30	5997.50	2032.19	10242.94	2246.06
	11	60.63	15.82	3521.88	928.02	4548.75	1949.05	8070.63	2041.52
	12	44.44	11.70	2638.11	650.85	2864.67	1273.03	5502.78	1482.57

(b)

ISLE	MONTH	Mean	
		Conch CPUE	s.e.
T	1	43.44	3.56
	2	33.31	2.10
	3	38.36	3.17
	4	36.43	3.06
	5	35.90	2.57
	6	31.14	2.13
	7	52.13	3.06
	8	53.06	2.81
	9	45.37	4.28
	10	40.16	3.07
	11	42.51	2.94
	12	42.73	2.68
X	1	57.87	1.89
	2	60.96	1.99
	3	55.73	1.85
	4	51.97	1.79
	5	55.23	1.85
	6	56.28	1.88
	7	88.45	5.24
	8	68.63	5.32
	9	66.42	4.77
	10	64.11	1.88
	11	58.09	1.69
	12	59.36	1.89

Table 15. (a). U.S. Virgin Islands. Estimated mean monthly landings and number of (conch-positive) trips by island (T= St. Thomas/St. John; X= St. Croix). Years 1986-1998 were combined. Standard errors (s.e.) of the estimates are provided. **(b)** Mean conch catch rates by month and island.

YEAR	CPUE-T	s.e.-T	CPUE-X	s.e.-X
1986	57.50	2.73	---	---
1987	58.87	2.04	83.19	4.34
1988	101.43	9.83	96.76	4.90
1989	50.00	10.00	69.37	2.69
1990	---	---	79.10	4.73
1991	---	---	74.25	2.06
1992	12.50	2.50	46.62	1.12
1993	41.67	1.80	54.92	2.28
1994	34.35	3.43	51.17	1.65
1995	31.37	1.90	46.62	1.50
1996	27.38	0.94	50.18	1.79
1997	24.23	0.97	55.91	1.56
1998	24.33	1.14	57.82	1.24
1999	23.79	0.93	---	---

Table 16. U.S. Virgin Islands. Mean nominal queen conch catch rates by island for years 1986-1999. T= St. Thomas/St. John; X= St. Croix; s.e.= standard error. Dashed lines represent years of missing/incomplete data or years when the fishery was closed (St Thomas/St. John 1988-1992).

St. Thomas/St. John								
YEAR	NUMBER OF TRIPS		LANDINGS		NOMINAL CATCH RATES			
	Num Trips,0	Num Trips,1	CONCH,0	CONCH,1	CPUE(CONCH,0)	Std Err(CPUE,0)	CPUE(CONCH,1)	Std Err(CPUE,1)
1986	70	49	4157	2685	59.39	2.13	54.80	5.92
1987	149	33	8556	2159	57.42	1.90	65.42	7.28
1988	14		1420		101.43	9.83		
1989	2		100		50.00	10.00		
1992	2		25		12.50	2.50		
1993	9	121	222	5195	24.67	10.26	42.93	1.74
1994	3	52	99	1790	33.00	23.90	34.42	3.45
1995	37	9	1070	373	28.92	1.70	41.44	5.91
1996	92	3	2545	56	27.66	0.96	18.67	0.67
1997	65	4	1573	99	24.20	0.94	24.75	7.71
1998	36		876		24.33	1.14		
1999	103	3	2397	125	23.27	0.81	41.67	16.67
St. Croix								
YEAR	Num Trips,0	Num Trips,1	CONCH,0	CONCH,1	CPUE(CONCH,0)	Std Err(CPUE,0)	CPUE(CONCH,1)	Std Err(CPUE,1)
1987	26		2163		83.19	4.34		
1988	185		17900		96.76	4.90		
1989	188		13041		69.37	2.69		
1990	130		10283		79.10	4.73		
1991	487		36161		74.25	2.06		
1992	344		16037		46.62	1.12		
1993	104	151	5569	8436	53.55	3.05	55.87	3.23
1994	174	488	8014	25862	46.06	2.44	53.00	2.06
1995	62	451	2882	21036	46.48	5.04	46.64	1.56
1996	152	120	6912	6738	45.47	2.36	56.15	2.66
1997	275	412	12904	25505	46.92	2.54	61.91	1.91
1998	305	458	15443	28671.5	50.63	2.07	62.60	1.50

Table 17. U.S. Virgin Islands. Number of positive conch trips, landings (in lbs) and nominal catch rates (in lb/trip) for the directed and non-directed sectors of the queen conch fishery. Estimates are given by island for years 1986-1999. Empty cells represent zeros. Note that the fishery was closed in St. Thomas/ St. John between 1988-1992. Notation: 0= Non-directed fishery; 1= Directed fishery.

St.Thomas/St.John		Conch		
YEAR	All fishers	All Conch	Full-Time	Part-time
1986	170	6	4	2
1987	169	7	4	3
1988	3	1		1
1989	55	1		1
1990	99			
1991	217			
1992	220	1		1
1993	198	9	6	3
1994	153	5	3	2
1995	215	8	5	3
1996	95	1		1
1997	22	1		1
1998	29	1		1
1999	8			

St.Croix		Conch			
Identifier	YEAR	All fishers	All Conch	Full-Time	Part-time
Id #	1986				
	1987	2	2		2
	1988	9	9		9
	1989	117	12		12
	1990	47	8		8
	1991	136	25		25
	1992	95	13		13
Boat #	1993	140	28	20	8
	1994	233	52	46	6
	1995	210	40	35	5
	1996	182	27	23	4
	1997	226	66	51	15
	1998	329	79	63	16
	1999	126			

Table 18. U.S.Virgin Islands. Estimates of the number of fishermen by year from the landings statistics database. The fishermen or vessel IDs by year in each island were used as a proxy. Estimates of the total number of fishermen, conch fishermen, full-time and part-time conch fishermen are provided. A conch fisherman = an ID# that harvested conch at least once during one year; Full-time conch fisherman= an ID# that targeted conch exclusively during one year; Part-time conch fisherman= an id # that harvested conch and other species. In St. Croix, catch reports from 1993 onward contained the boat ID instead of the fisherman ID. Both identifiers could not be linked in the present study, but were assumed to be equivalent.

Year	Total No. Tip-Tickets	Not Reporting Conch	Reporting Conch
1983	26872	25266	1606
1984	15129	14003	1126
1985	12796	11827	969
1986	17123	15156	1967
1987	18481	16532	1949
1988	21410	18724	2686
1989	24685	22924	1761
1990	21627	20351	1276
1991	26966	25021	1945
1992	20692	19205	1487
1993	24944	22834	2110
1994	28122	25796	2326
1995	39529	36279	3250
1996	42777	39442	3335
1997	43465	40752	2713
1998	34411	31977	2434
1999	32536	30354	2182
2000	34122	31281	2841

Table 19. Estimated number of trip-tickets collected in Puerto Rico for years 1983-2000. The number of tickets that reported and that did not report queen conch landings are given.

YEAR	LANDINGS			Total No. Trips
	Total	Conch	Other Spp.	
1983	3966228	401340	3564888	62668
1984	3190719	295960	2894759	53598
1985	2927215	263872	2663343	46483
1986	2880063	207877	2672186	29677
1987	2453346	161204	2292142	23481
1988	2111811	235853.3	1875958	29266
1989	2376644	162675.3	2213968	34434
1990	2218127	109615.3	2108512	31568
1991	2486804	108765	2378039	44798
1992	2057660	92163	1965497	31839
1993	2536084	166201.3	2369883	40217
1994	2755600	172202	2583398	46021
1995	3779203	217600	3561603	71837
1996	3768542	258327.8	3510214	85090
1997	3971836	241049.4	3730787	85097
1998	3618152	272338.4	3345814	69541
1999	3412235	220437.4	3191798	70387
2000	3316803	284480.3	3032322	63568
Total	53827072	3871962	49955111	919570

Table 20. Total estimated landings and number of trips for the combined multispecies fishery of Puerto Rico (1983-2000). The aggregated catch of all species excluding conch is labeled "Other Spp.," and conch landings are also provided. The total number of trips is the sum of all the trips reported each year. Multiple trips reported within one trip-ticket were included.

MONTH	MEAN TRIPS		MEAN MONTHLY LANDINGS					
		s.e.	Conch	s.e.	Other Spp	s.e.	Total	s.e.
1	4507.333	460.7147	19362.92	2261.101	246106.2	17529.17	265469.1	18914.29
2	4362.667	446.7628	19422.9	2061.841	235455.6	14880.95	254878.5	16332.38
3	4666.944	455.4939	21586.04	2059.01	262989.2	16149.43	284575.2	17523.17
4	4553.611	417.1836	20927.55	2240.613	248948.2	16195.28	269875.7	17790.79
5	4915.278	484.5361	21768.31	2268.676	260038.9	14020.13	281807.2	15828.18
6	4335.556	417.7042	18430.82	1834.692	225366.8	14131.47	243797.6	15180.12
7	4195.5	420.626	15576.14	1941.267	224887.8	12424.31	240464	12724.28
8	4615.167	447.8847	16749.27	2642.462	242498.9	13074.82	259248.2	13893.57
9	4061.389	324.2433	12983.13	1715.068	213142.1	11703.54	226125.2	12581.68
10	4140.5	387.2146	18037.69	2226.948	220675.6	13233.41	238713.3	14418.12
11	3516.056	359.8341	16159.16	1987.412	201034.7	10934.29	217193.8	12374.7
12	3217.222	318.3972	14105.03	1575.623	194140	10973.4	208245.1	11818.88

Table 21. Puerto Rico. Estimated mean landings and mean number of trips by month for years 1983-2000 combined. Standard errors (s.e.) of the estimates are provided.

(a)

ALL TRIPS REPORTED

By Year		
YEAR	CPUE-All Trips	s.e.
1983	68.50	0.95
1984	72.28	1.66
1985	76.86	1.80
1986	123.31	2.08
1987	117.84	2.27
1988	85.76	1.45
1989	79.74	1.43
1990	84.65	1.32
1991	69.99	0.87
1992	80.65	2.26
1993	84.36	2.09
1994	76.13	1.11
1995	73.09	1.05
1996	59.32	0.64
1997	67.08	1.00
1998	77.17	1.09
1999	70.78	0.96
2000	70.02	0.81
Mean	79.86	

By Month		
MONTH	CPUE- All Trips	s.e.
1	76.49	0.90
2	75.48	0.87
3	77.52	0.90
4	78.77	1.06
5	76.21	0.89
6	73.79	0.98
7	75.91	1.39
8	75.10	1.25
9	74.34	1.00
10	75.51	0.90
11	81.49	1.15
12	84.08	1.40

Table 22. Puerto Rico. Estimated nominal catch rates by year and by month for all the species combined. CPUEs were estimated: (a) using all the trips reported and, (b) using only the records that reported single trips. CPUE units are pounds per trip (lb/trip), s.e.= standard error. (Compare to **Table 33**).

(b)

SINGLE TRIP RECORDS

By Year		
YEAR	CPUE-1 trip/record	s.e.
1983	79.32	1.75
1984	114.86	5.94
1985	117.86	5.97
1986	202.94	4.76
1987	171.18	5.05
1988	98.22	2.13
1989	94.41	2.03
1990	93.63	1.60
1991	77.20	1.05
1992	87.32	2.62
1993	93.99	2.49
1994	82.92	1.45
1995	82.46	1.35
1996	72.60	0.98
1997	85.03	1.42
1998	101.64	1.91
1999	83.52	1.32
2000	79.17	1.09
Mean	101.01	

By Month		
MONTH	CPUE-1 Trip/record	s.e.
1	92.35	1.30
2	90.94	1.25
3	91.48	1.31
4	94.80	1.68
5	91.46	1.37
6	88.84	1.50
7	92.28	2.32
8	90.99	1.80
9	90.16	1.53
10	90.19	1.33
11	97.41	1.85
12	100.97	1.97

Table 22. (b) (Cont.) Puerto Rico. Estimated nominal catch rates by year and by month for all the species combined. CPUE units are pounds per trip (lb/trip). Annual CPUEs are also given in **Table 33**.

		LANDINGS (1983-2000)			
COAST	MUNICIPALITY	No. TRIPS	CONCH	OTHER SPP	TOTAL
Unknown	0	15		197	197
NORTH	1	5,839	3,748	184,185.6	187,933.6
	2	13		214.5	214.5
	3	3,246	231	123,070.1	123,301.1
	4	3,815		151,556.3	151,556.3
	5	16,561	1,535	512,676.1	514,211.1
	6	7,202	230	380,144.3	380,374.3
	7	2,705	1,072	115,830.9	116,902.9
	8	7,318	190.5	249,109	249,299.5
	9	9,040	328	240,227.8	240,555.8
	10	6,865	1,611	267,427.1	269,038.1
	11	685	243	38,465	38,708.0
	12	21,913	2,126	885,803.3	887,929.3
	13	28,839	5,341	1,326,005	1,331,346
	14	7,903	2,202	362,581.7	364,783.9
	15	12,662	14,517	944,133.3	958,650.1
	16	5,492	6,040	239,124.5	245,164.5
	17	5,080	12,239	390,719.9	402,958.9
EAST	18	25,172	191,179	1,721,298	1,912,477
	19	19,873	117,057.8	832,993.5	950,051.2
	20	24,887	215,550.5	1,455,615	1,671,166
	21	29,747	25,745.3	1,119,220	1,144,966
	22	17,965	16,437.5	542,912.8	559,350.3
	23	10,482	8,582.0	409,263.1	417,845.1
	24	9,590	16,431.9	349,863	366,294.9
	25	22,176	255,189.9	1,478,478	1,733,668
SOUTH	26	12,646	190,251.1	444,003.6	634,254.7
	27	17,475	24,808.5	759,457.4	784,265.9
	28	25,099	5,088.5	2,221,731	2,226,819
	29	37,780	15,073	1,303,108	1,318,181
	30	15,558	28,318	582,864.4	611,182.4
	31	34,833	169,987	1,890,931	2,060,918.0
	32	21,023	14,838.3	789,942.2	804,780.4
	33	30,121	163,318.3	727,888.8	891,207
	34	13,639	6,028.5	484,385.8	490,414.3
	35	48,103	94,795.9	2,238,707	2,333,503
	36	61,011	50,248.0	2,500,033	2,550,281
WEST	37	166,836	2,093,737	13,582,025	15,675,761
	38	40,808	105,318.6	1,754,594	1,859,913
	39	9,531	628	423,191.2	423,819.2
	40	14,968	2,960	1,132,700	1,135,660
	41	17,819	262.8	1,617,507	1,617,769
	42	47,232	8,473	3,180,934	3,189,407
Total		919,567	3,871,961.7	49,955,118.2	53,827,079.3

Table 23. Puerto Rico. Landings and total number of trips by coast and municipality (county) for years 1983-2000. Municipality codes are given in **Appendix B**.

COAST	Mean(CPUE)	s.e.
NORTH	64.63	0.69
EAST	65.41	0.66
SOUTH	60.17	0.37
WEST	105.61	0.68

COAST	MUNICIPALITY	Mean(CPUE)	s.e.
NORTH	1	44.83	1.79
	2	17.98	5.69
	3	52.78	2.54
	4	58.61	2.34
	5	43.25	0.90
	6	91.67	3.56
	7	69.70	4.94
	8	54.15	1.88
	9	52.19	1.29
	10	52.42	1.49
	11	84.20	21.94
	12	61.54	1.29
	13	59.84	1.27
	14	58.47	1.46
	15	109.31	5.06
	16	59.62	1.32
	17	128.33	5.24
EAST	18	85.13	1.32
	19	61.11	0.45
	20	71.23	0.83
	21	48.27	0.82
	22	54.89	1.46
	23	47.99	2.39
	24	38.84	0.58
	25	92.64	6.08
SOUTH	26	61.59	1.43
	27	60.50	1.40
	28	112.05	1.84
	29	46.84	1.35
	30	56.79	1.71
	31	66.41	0.79
	32	57.28	1.42
	33	33.35	0.27
	34	47.05	1.09
	35	57.19	1.14
	36	64.55	0.77
WEST	37	140.90	1.35
	38	60.64	0.84
	39	56.18	2.17
	40	119.41	4.00
	41	100.87	1.21
	42	72.47	0.63
Unknown	0	20.33	5.04

Table 24. Puerto Rico. Mean nominal catch rates by coast and by municipality for all species and years (1983-2000) combined. Municipality codes are provided in **Appendix B**. CPUE units are pounds per trip (lb/trip). s.e.= standard errors.

CODE	Common Name	TOTAL LANDINGS	Percent	Cumul %
139	Snapper,silk	4819703.6	9.28%	9.28%
901	Lobster,carib. spiny	4048244.2	7.79%	17.07%
900	Conch,queen	3767389.2	7.25%	24.33%
140	Snapper,yellowtail	3302730.67	6.36%	30.69%
155	Grunt,white	3016094.49	5.81%	36.49%
136	Snapper,lane	2724500.02	5.25%	41.74%
796	First class	2296951.32	4.42%	46.16%
79	Sea basses	2184456.46	4.21%	50.37%
233	Mackerel,king	2049538.12	3.95%	54.31%
192	Parrotfishes	1902253.27	3.66%	57.98%
797	Second class	1845461.45	3.55%	61.53%
127	Dolphins	1401897.43	2.70%	64.23%
795	Other fishes	1290546.06	2.48%	66.71%
225	Mackerels & tunas	1286232.25	2.48%	69.19%
134	Snapper,mutton	926841.1	1.78%	70.97%
251	Triggerfish,queen	870464.91	1.68%	72.65%
256	Boxfishes	860546.99	1.66%	74.31%
798	Third class	855069.69	1.65%	75.95%
130	Snappers	777970.63	1.50%	77.45%
189	Hogfish	774640.36	1.49%	78.94%
199	Mullet,white	716123.16	1.38%	80.32%
109	Jacks	637755.36	1.23%	81.55%
75	Snooks	624842.82	1.20%	82.75%
88	Hind,red	622015.58	1.20%	83.95%
8	Sharks,requiem	589931.77	1.14%	85.09%
55	Ballyhoo	531179.32	1.02%	86.11%
234	Mackerel,cero	461178.76	0.89%	87.00%
143	Snapper,queen	454099.97	0.87%	87.87%
902	Octopus,g:octopus	449934.74	0.87%	88.74%
164	Porgies	441797.05	0.85%	89.59%
174	Goatfishes	377474.75	0.73%	90.32%
226	Tuna,yellowfin	376709.65	0.73%	91.04%

Table 25. Puerto Rico. Catch composition of the aggregated (multispecies) landings for years 1983-2000. The values are illustrated as fractions (%) of the total landings. Only the species/ species groups that represented >0.7% of the total catch (and that added up to a cumulative 90%) are shown; the other species had a very small representation. A 7.25 % of the total corresponded to queen conch landings.

GEARCODE	Name	N Trips	TOTWT	% Trips	% TotWT
101	Fish Pot	390539	14873402	32.8%	28.6%
104	Bottom Line	307793	12807850	25.8%	24.7%
116	Scuba Diving	166968	7261855	14.0%	14.0%
103	Gill Net	131873	6002231	11.1%	11.6%
105	Troll Line	79306	4491908	6.7%	8.6%
100	Beach Seine	26264	1946658	2.2%	3.7%
118	Trammel Net	23633	2161930	2.0%	4.2%
114	Skin Diving	14525	319895.5	1.2%	0.6%
U	Unknown	13727	683141.3	1.2%	1.3%
109	Cast Net	11565	360619.1	1.0%	0.7%
110	Spear Fishing	11410	484701.8	1.0%	0.9%
102	Lobster Pot	9487	381763.7	0.8%	0.7%
108	Land Crab Trab	1709	37798	0.1%	0.1%
112	Rod and Reel	842	32688.75	0.1%	0.1%
111	Other	646	35171.05	0.1%	0.1%
115	By Hand	626	38659.15	0.1%	0.1%
106	Silk Haul	221	8709.5	0.019%	0.017%
119	Snare	88	1989.25	0.007%	0.004%
113	Hand Troll Line	50	2309.5	0.004%	0.004%
117	Hand Line	42	4534.5	0.004%	0.009%
	Total	1191314	51937815	100%	100%

Table 26. Puerto Rico. Gears most frequently used in the multispecies fishery (1983-2000). The proportions (%) of the total trips and of the total weight harvested with each gear are provided.

(a)

Year	TRIPS			LANDINGS		
	Positive Conch	Other Spp Only	TOTAL	Conch	Other Spp.	TOTAL
1983	439	13748	14187	36805	1088477	1125282
1984	92	3737	3829	8140	431675	439815
1985	145	3324	3469	13099	395753	408852
1986	873	8618	9491	144703	1781378	1926081
1987	886	11532	12418	144292	1981397	2125689
1988	2282	15642	17924	219073.3	1541469	1760542
1989	1502	18286	19788	113288.3	1754918	1868207
1990	1121	17286	18407	95337.25	1628074	1723411
1991	1655	20704	22359	90429.45	1635614	1726044
1992	1330	16537	17867	72456.5	1487748	1560204
1993	1764	19286	21050	129222.3	1849166	1978389
1994	1969	21990	23959	101726.1	1884988	1986714
1995	2650	29740	32390	154228.5	2516663	2670891
1996	2639	29074	31713	133466.2	2168774	2302240
1997	2247	29639	31886	137305	2573814	2711119
1998	1686	22573	24259	180506.4	2285287	2465794
1999	1606	23292	24898	155028.9	1924362	2079391
2000	2394	25326	27720	223356	1971197	2194553
Total	27280	330334	357614	2152463.2	30900754	33053218

(b)

NUMBER OF TRIPS									
Year	Conch-Positive	Conch-Directed	Conch-Non-Directed	Other Spp Only	Total	% Conch-Positive	% Conch-Directed	% Other Spp Only	
1983	439	203	236	13984	14187	3.09%	1.43%	98.57%	
1984	92	54	38	3775	3829	2.40%	1.41%	98.59%	
1985	145	55	90	3414	3469	4.18%	1.59%	98.41%	
1986	873	169	704	9322	9491	9.20%	1.78%	98.22%	
1987	886	204	682	12214	12418	7.13%	1.64%	98.36%	
1988	2282	666	1616	17258	17924	12.73%	3.72%	96.28%	
1989	1502	434	1068	19354	19788	7.59%	2.19%	97.81%	
1990	1121	229	892	18178	18407	6.09%	1.24%	98.76%	
1991	1655	366	1289	21993	22359	7.40%	1.64%	98.36%	
1992	1330	338	992	17529	17867	7.44%	1.89%	98.11%	
1993	1764	452	1312	20598	21050	8.38%	2.15%	97.85%	
1994	1969	543	1426	23416	23959	8.22%	2.27%	97.73%	
1995	2650	678	1972	31712	32390	8.18%	2.09%	97.91%	
1996	2639	613	2026	31100	31713	8.32%	1.93%	98.07%	
1997	2247	541	1706	31345	31886	7.05%	1.70%	98.30%	
1998	1686	463	1223	23796	24259	6.95%	1.91%	98.09%	
1999	1606	384	1222	24514	24898	6.45%	1.54%	98.46%	
2000	2394	642	1752	27078	27720	8.64%	2.32%	97.68%	

Table 27. Puerto Rico (1993-2000). (a) Total landings and number of trips reported in single-trip records (b) Number of trips by trip category (conch-positive, conch-directed, conch-non-directed, other species only, total) and their proportions with respect to the total number of trips.

NUMBER OF TRIPS			
Year	Non-Directed	Directed	Tot Conch Trips
1983	236	203	439
1984	38	54	92
1985	90	55	145
1986	704	169	873
1987	682	204	886
1988	1,616	666	2,282
1989	1,068	434	1,502
1990	892	229	1,121
1991	1,289	366	1,655
1992	992	338	1,330
1993	1,312	452	1,764
1994	1,426	543	1,969
1995	1,972	678	2,650
1996	2,026	613	2,639
1997	1,706	541	2,247
1998	1,223	463	1,686
1999	1,222	384	1,606
2000	1,752	642	2,394
Total	20,246	7,034	27,280
% Conch Only	25.78%		

LANDINGS			
Year	Non-Directed	Directed	Tot Conch Landings
1983	17,835	18,970	36,805
1984	2,525	5,615	8,140
1985	8,309	4,790	13,099
1986	121,775	22,928	144,703
1987	117,744.3	26,547.8	144,292.1
1988	136,970.3	82,103.0	219,073.3
1989	75,870.8	37,417.5	113,288.3
1990	75,877.5	19,459.8	95,337.3
1991	65,859.7	24,569.8	90,429.5
1992	49,020.5	23,436	72,456.5
1993	97,256.5	31,965.8	129,222.3
1994	70,078.8	31,647.3	101,726.1
1995	100,608.8	53,619.8	154,228.6
1996	91,538.2	41,928	133,466.2
1997	96,786.3	40,518.8	137,305
1998	141,973.5	38,532.9	180,506.4
1999	114,873.2	40,155.8	155,029
2000	168,766	54,590	223,356
Total	1,553,668.3	598,795	2,152,463.3
% Conch Only	27.82%		

Table 28. Puerto Rico (1983-2000). Total queen conch landings and number of trips in the directed and non-directed sectors of the fishery. Only single-trip records were used.

LANDINGS				
MONTH	Single-trip records		All records	
	Mean	s.e.	Mean	s.e.
	Conch Landings		Conch Landings	
1	9399.25	1320.72	19362.92	2261.10
2	10661.78	1750.58	19422.90	2061.84
3	12524.26	1580.92	21586.04	2059.01
4	11429.35	1802.02	20927.55	2240.61
5	12330.21	1737.81	21768.31	2268.68
6	10633.56	1548.09	18430.82	1834.69
7	8814.71	1585.98	15576.14	1941.27
8	8372.01	1613.46	16749.27	2642.46
9	6983.31	1360.62	12983.13	1715.07
10	10096.63	1921.18	18037.69	2226.95
11	10043.95	1703.51	16159.16	1987.41
12	8035.62	1440.67	14105.03	1575.62

NUMBER OF TRIPS		
MONTH	Mean Positive Conch Trips	s.e.
1	125.11	16.50
2	138.83	18.65
3	165.11	20.50
4	167.17	19.71
5	195.17	22.61
6	163.44	22.02
7	123.78	22.65
8	125.28	23.12
9	108.94	19.39
10	154.94	23.58
11	129.00	19.24
12	111.72	16.82

Table 29. Puerto Rico. Estimated mean queen conch landings and number of positive conch trips by month for years 1983-2000. Monthly catch estimates obtained using all records (that include multiple-trips in a record) and single-trip records are provided in the Landings table above. The mean number of trips by month were estimated using only single-trip records. S.e.= standard errors of the estimates.

Gear Name	Gear Code	Frequency
Scuba Diving	116	82.04%
Spear Fishing	110	8.42%
Skin Diving	114	5.00%
Fish Pot	101	1.85%
Bottom Line	104	1.01%
Other	111	0.55%
Gill Net	103	0.36%
Trammel Net	118	0.31%
By Hand	115	0.11%
Troll Line	105	0.11%
Lobster Pot	102	0.09%
Long Line	107	0.05%
Beach Seine	100	0.03%
Cast Net	109	0.02%
Rod and Reel	112	0.01%
Snare	119	0.01%
Silk Haul	106	0.01%

Table 30. Puerto Rico (1983-2000). Gears used in the queen conch fishery. The frequency (%) of use of each gear is provided.

YEAR	Mean Price (US\$ /lb)	s.e.
1983	\$1.34	\$0.01
1984	\$1.36	\$0.01
1985	\$1.50	\$0.02
1986	\$1.60	\$0.01
1987	\$1.70	\$0.01
1988	\$1.82	\$0.01
1989	\$1.93	\$0.01
1990	\$1.99	\$0.01
1991	\$2.04	\$0.02
1992	\$2.12	\$0.01
1993	\$2.13	\$0.01
1994	\$2.14	\$0.01
1995	\$2.24	\$0.01
1996	\$2.23	\$0.01
1997	\$2.25	\$0.02
1998	\$2.22	\$0.01
1999	\$2.25	\$0.01
2000	\$2.30	\$0.01

Table 31. Puerto Rico (1983-2000). Mean price of queen conch meat by year (in US dollars per pound). S.e.= standard error.

Common Name	Sp Name	Sp_Code	% Trips	% Weight
Third class		798	3.9%	2.7%
Grunt, white	<i>Haemulon plumieri</i>	155	5.8%	1.3%
First class		796	6.7%	3.7%
Parrotfishes	Scaridae	192	6.9%	1.0%
Boxfishes	Ostraciidae	256	7.9%	1.0%
Sea basses	Serranidae	79	11.3%	2.9%
Triggerfish, queen	<i>Balistes vetula</i>	251	13.0%	1.5%
Octopus	<i>Octopus, octopus</i>	902	15.2%	1.7%
Hogfish	<i>Lachnolains maximus</i>	189	22.6%	3.3%
Snappers (mutton,lane silk,yellow,other)	Lutjanidae	130, 134, 136 139, 140	28.8%	5.9%
Lobster, carib.spiny	<i>Panulirus argus</i>	901	63.4%	11.6%
Conch, queen	<i>Strombus gigas</i>	900	100.0%	56.4%

Table 32. Puerto Rico (1983-2000). Species associated to the queen conch fishery. The representation of each species in positive queen conch trips is given as the proportion (%) of trips present (species with >4% presence) and as a proportion of the total weight landed in conch trips (species with >1% of total weight). The data was combined for all years.

Year	CPUE Conch	SE Conch	CPUE Other Spp	SE Other	CPUE All	SE All
1983	83.84	4.38	77.84	1.77	79.32	1.75
1984	88.48	10.70	114.35	6.02	114.86	5.94
1985	90.34	12.29	115.92	6.01	117.86	5.97
1986	165.75	8.51	191.09	4.68	202.94	4.76
1987	162.86	9.16	162.22	5.05	171.18	5.05
1988	96.00	2.02	89.32	2.18	98.22	2.13
1989	75.42	6.77	90.67	1.91	94.41	2.03
1990	85.05	6.58	89.56	1.54	93.63	1.60
1991	54.64	2.91	74.37	1.03	77.20	1.05
1992	54.48	2.59	84.87	2.58	87.32	2.62
1993	73.26	4.05	89.77	2.44	93.99	2.49
1994	51.66	2.38	80.50	1.46	82.92	1.45
1995	58.20	2.31	79.36	1.36	82.46	1.35
1996	50.57	1.82	69.74	0.99	72.60	0.98
1997	61.11	2.75	82.11	1.43	85.03	1.42
1998	107.06	7.18	96.04	1.83	101.64	1.91
1999	96.53	6.47	78.50	1.25	83.52	1.32
2000	93.30	5.12	72.80	0.96	79.17	1.09

Table 33. Puerto Rico (1983-2000). Estimated nominal catch rates by year for all the species combined (All), for queen conch (Conch) and for all other species, excluding conch (Other Spp.). All CPUEs were estimated using single-trip records. Units are pounds per trip (lb/trip). SE= standard errors.

All Conch			Non-Directed Sector (ND)			Directed Sector (D)		
Year	CPUE All Conch Trips	SE	Year	CPUE- ND	SE	Year	CPUE-D	SE
1983	83.84	4.38	1983	75.57	6.95	1983	93.45	4.86
1984	88.48	10.70	1984	66.45	16.06	1984	103.98	14.04
1985	90.34	12.29	1985	92.32	19.36	1985	87.09	7.16
1986	165.75	8.51	1986	172.98	10.35	1986	135.67	8.14
1987	162.86	9.16	1987	172.65	11.22	1987	130.14	13.09
1988	96.00	2.02	1988	84.76	2.49	1988	123.28	3.12
1989	75.42	6.77	1989	71.04	9.43	1989	86.22	3.34
1990	85.05	6.58	1990	85.06	7.69	1990	84.98	11.78
1991	54.64	2.91	1991	51.09	3.66	1991	67.13	2.64
1992	54.48	2.59	1992	49.42	3.28	1992	69.34	3.20
1993	73.26	4.05	1993	74.13	5.37	1993	70.72	2.51
1994	51.66	2.38	1994	49.14	3.18	1994	58.28	2.13
1995	58.20	2.31	1995	51.02	2.69	1995	79.09	4.44
1996	50.57	1.82	1996	45.18	2.14	1996	68.40	3.34
1997	61.11	2.75	1997	56.73	3.32	1997	74.90	4.48
1998	107.06	7.18	1998	116.09	9.69	1998	83.22	5.23
1999	96.53	6.47	1999	94.00	8.11	1999	104.57	8.21
2000	93.30	5.12	2000	96.33	6.80	2000	85.03	4.44

Table 34. Puerto Rico (1983-2000). Estimated nominal catch rates by year for the two sectors of the queen conch fishery (Directed/ Non-Directed) and for the whole fishery (All Conch Trips). All CPUEs were estimated using single-trip records. Units are pounds per trip (lb/trip). SE= standard errors.

(a)

ALL SPECIES						
MONTH	ALL CONCH	s.e.	OTHER SPP	s.e.	TOTAL	s.e.
1	79.18	5.82	98.86	7.87	104.46	7.94
2	85.90	7.91	95.51	7.16	101.75	7.25
3	84.15	5.44	89.79	4.33	96.52	4.68
4	85.09	11.78	92.96	8.26	99.69	9.24
5	82.51	10.20	92.72	8.21	99.01	8.74
6	77.27	9.76	86.95	8.01	93.21	8.76
7	132.63	40.02	103.90	11.01	110.35	11.79
8	92.05	15.33	97.20	10.38	102.88	11.27
9	92.67	16.31	92.64	10.17	97.56	11.04
10	87.76	12.88	93.80	8.75	100.23	9.18
11	95.55	9.23	101.52	8.80	108.66	9.15
12	83.03	9.84	109.32	9.32	115.12	9.14

(b)

QUEEN CONCH						
Month	ALL CONCH	s.e.	Non-Directed	s.e.	Directed	s.e.
1	79.18	5.82	78.31	7.67	81.62	5.24
2	85.90	7.91	82.10	9.87	83.87	6.06
3	84.15	5.44	72.38	6.15	93.43	7.60
4	85.09	11.78	83.54	14.17	84.55	8.57
5	82.51	10.20	77.99	12.17	79.55	5.10
6	77.27	9.76	71.96	9.89	90.34	12.07
7	132.63	40.02	130.47	41.17	88.71	8.90
8	92.05	15.33	88.12	18.90	85.36	6.66
9	92.67	16.31	94.20	18.24	84.56	12.64
10	87.76	12.88	90.55	21.38	81.37	7.08
11	95.55	9.23	98.17	11.41	89.03	6.91
12	83.03	9.84	78.43	9.98	95.37	13.94

Table 35. Puerto Rico. (a) Estimated nominal catch rates by month for all the species combined (Total), for queen conch and for all other species. (b) Estimated nominal catch rates for the two sectors of the queen conch fishery (directed/ non-directed) and for the whole fishery (All conch). All CPUEs were estimated using single-trip records. Estimates are the monthly means by year averaged over years 1983-2000. CPUE units are lb/trip; s.e.= standard errors.

(a)

ALL SPECIES- Mean CPUE by Coast				
COAST	All Data	s.e.	Single-Trip	s.e.
NORTH	64.63	0.69	72.64	0.80
EAST	65.41	0.66	67.51	0.42
SOUTH	60.17	0.37	65.65	0.40
WEST	105.61	0.68	112.93	0.78

(b)

GROUPED SPP.- Mean CPUE by Coast						
COAST	Conch	s.e.	Other Species	s.e.	All Species	s.e.
NORTH	60.25	4.75	72.12	0.80	72.64	0.80
EAST	80.28	1.39	60.88	0.40	67.51	0.42
SOUTH	41.42	0.50	61.80	0.39	65.65	0.40
WEST	92.98	2.14	105.00	0.75	112.93	0.78

(c)

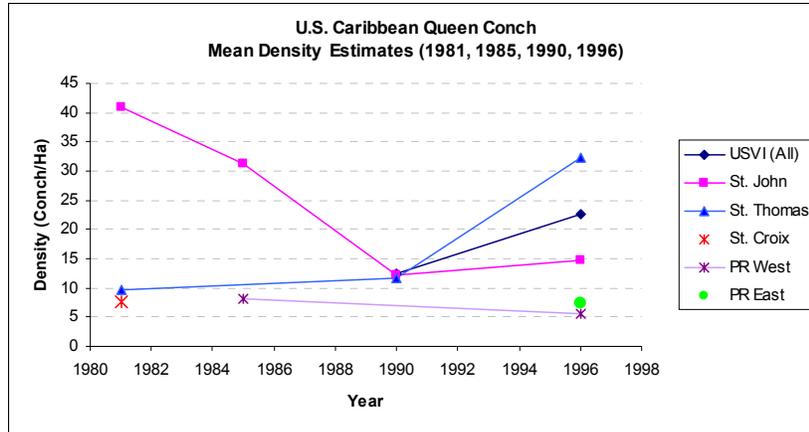
CONCH Mean CPUE by Coast		
COAST	Conch	s.e.
NORTH	60.25	4.75
EAST	81.50	1.70
SOUTH	41.58	0.53
WEST	92.98	2.14

Table 36. Puerto Rico (1983-2000). Mean nominal catch rates by coast for: (a) All species combined. CPUE estimates for all landings data and for single-trip records are provided. (b) Grouped species (all, conch, other) by coast. (c) Queen conch by coast. Only single-trip records were used in (b) and (c). CPUE units are lb/trip; s.e.= standard errors.

YEAR	ALL Fishers	CONCH	
		All Conch	Full-Time
1983	2038	296	137
1984	1595	254	101
1985	1857	256	88
1986	1580	239	60
1987	1322	188	75
1988	1366	231	116
1989	1437	225	127
1990	1268	190	70
1991	1452	244	81
1992	1234	188	82
1993	1298	214	87
1994	1531	279	116
1995	2098	391	151
1996	2254	417	180
1997	2373	392	159
1998	2254	350	129
1999	1972	343	108
2000	1979	352	143

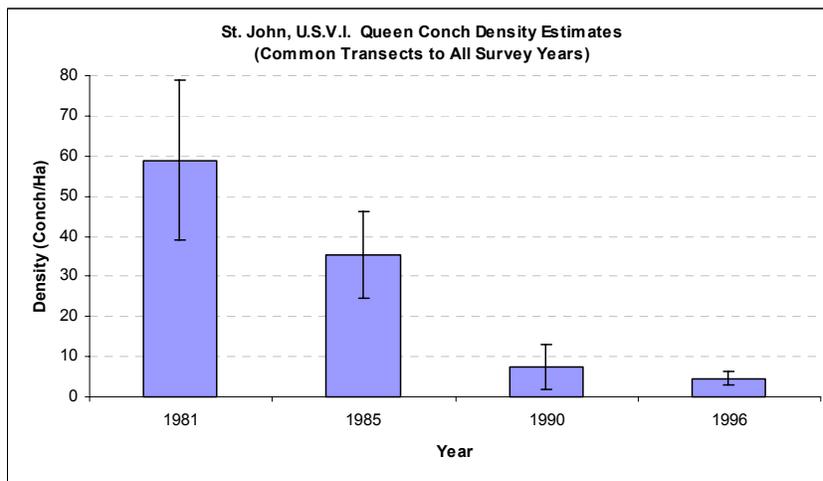
Table 37. Puerto Rico (1983-2000). Estimates of the number of fishermen by year from the landings statistics database. The fishermen ID numbers by year were used as a proxy. Estimates of the total number of fishermen, conch fishermen, and full-time conch fishermen are provided. A conch fisherman = an ID # that harvested conch at least once during one year; "Full-time" conch fisherman = an ID # that targeted conch exclusively during one year. Proportions fluctuated during the year, these are overall approximations. Mean proportions of fishermen by island for the whole U.S Caribbean are illustrated in **Figure 24**.

FIGURES



Density Estimates (Conch/Ha)		U.S. Virgin Islands				Puerto Rico	
Year	Source	USVI (All)	St. John	St. Thomas	St. Croix	PR West	PR East
1981	Wood and Olsen (1983)		40.87 (52.08)	9.7	7.6		
1985	Boulon (1987)		31.29 (30.83)			8.11	
1990	Appeldoorn (1991) and Friedlander et al. (1994)	12.35 (18.42)	12.10 (20.35)	11.79 (15.01)			
1996	Appeldoorn (1996) and Friedlander (1997)	22.66	14.71 (35.33)	32.19		5.68	7.28

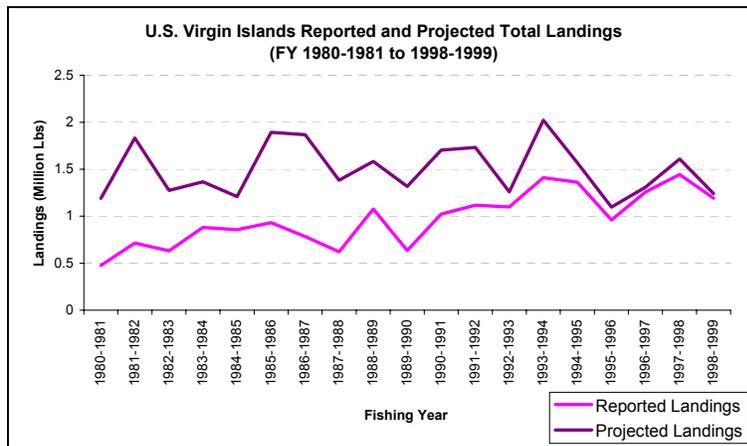
Figure 1. Estimates of queen conch density in the U.S. Caribbean from fishery-independent survey reports. Densities are given in number of conchs per hectare; numbers in parentheses are standard deviations. The sources for each estimate are provided.



St. John, U.S.V.I.		
Year	Density (conch/ha)	S.E.
1981	58.96	19.79
1985	35.2	10.78
1990	7.37	5.6
1996	4.63	1.71

Figure 2. Mean densities of adult queen conch in St. John, U.S.V.I. Only the transects common to all survey years were used. S.E. are standard errors. Results and graph taken from Friedlander (1987).

(a)



(b)

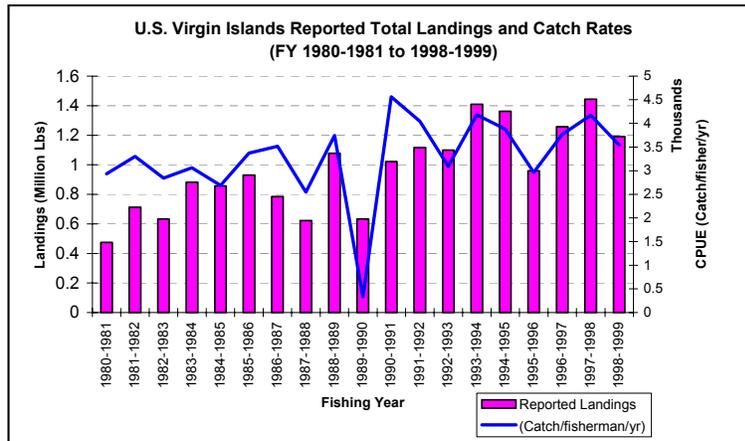


Figure 3. U.S. Virgin Islands commercial landings statistics (Fishing Years 1980-1981 to 1998-1999). (a) Reported and projected total landings. Projected landings= proportion of reporting fishermen * total reported landings. (b) Reported total landings and estimated catch rates (lb/fisher/year). Sources: Annual Reports of the Cooperative Fishery Statistics Program (DFW/DPNR1984-2000).

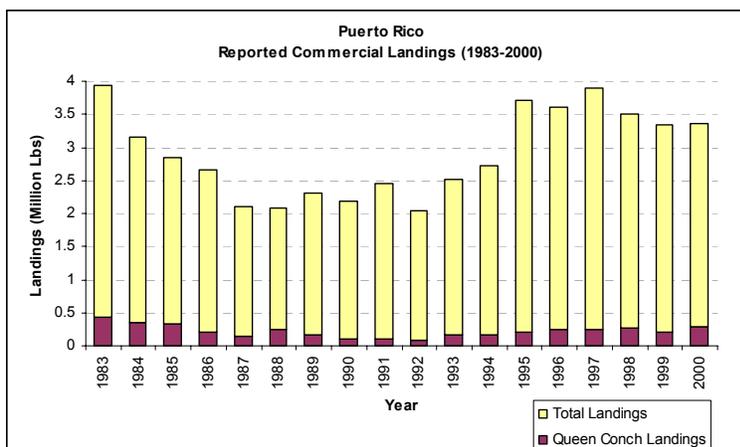
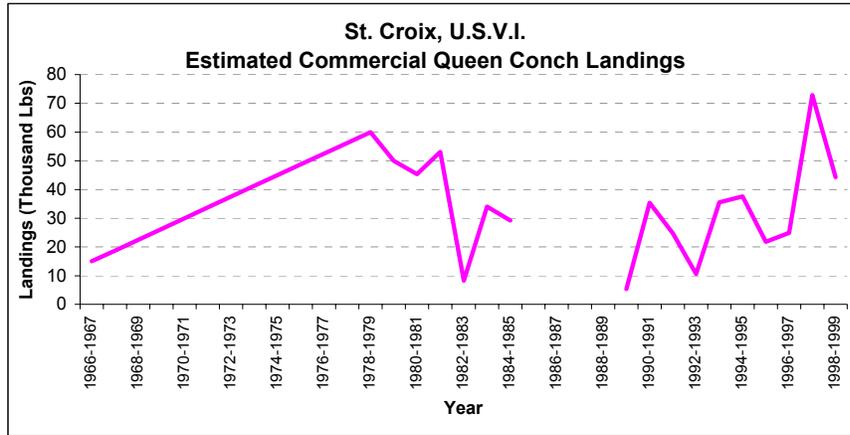


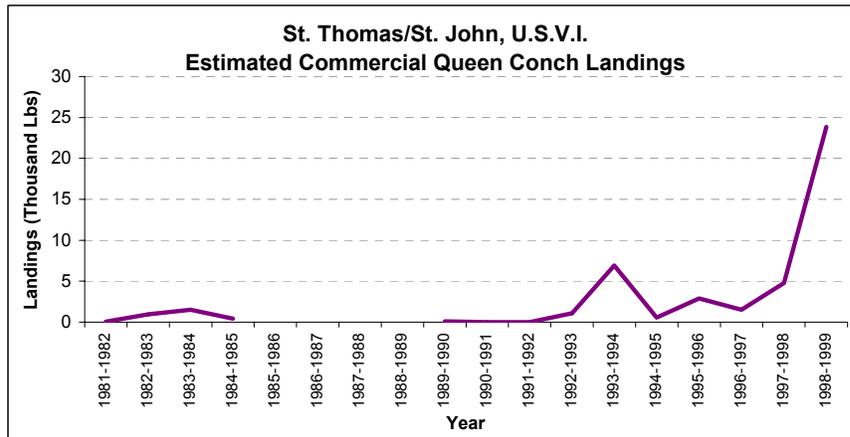
Figure 4. Puerto Rico commercial landings (1983-2000) reported in the Annual Reports of the Cooperative Fishery Statistics Program (FRL/DNER 1984-2001). The total landings include the conch landings.

Historical Commercial Queen Conch Landings

(a)



(b)



(c)

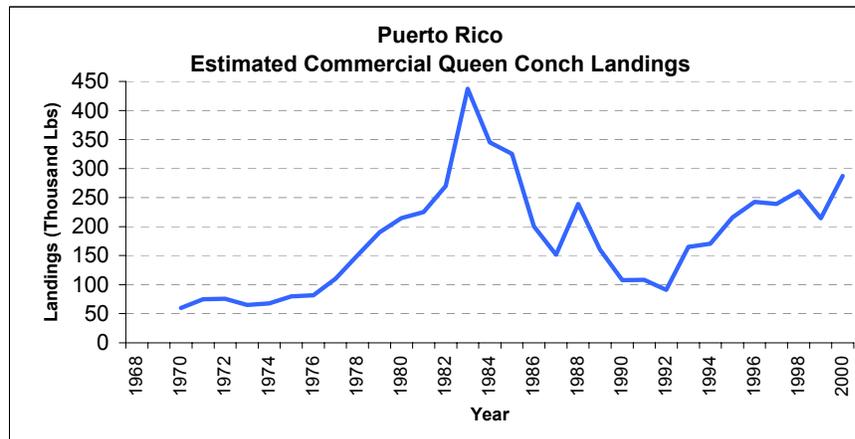


Figure 5. Estimated commercial queen conch landings in Puerto Rico and the U.S. Virgin Islands. **(a)** St. Croix, U.S.V.I. **(b)** St. Thomas-St. John, U.S.V.I. Sources: Wood and Olsen (1983), DFNR Annual Cooperative Statistics Reports (1984-1999), García-Moliner (1996). **(c)** Puerto Rico. Sources: Appeldoorn (1991), García-Moliner (1996), FRL/DNER Annual Cooperative Statistics Reports (1993-2001).

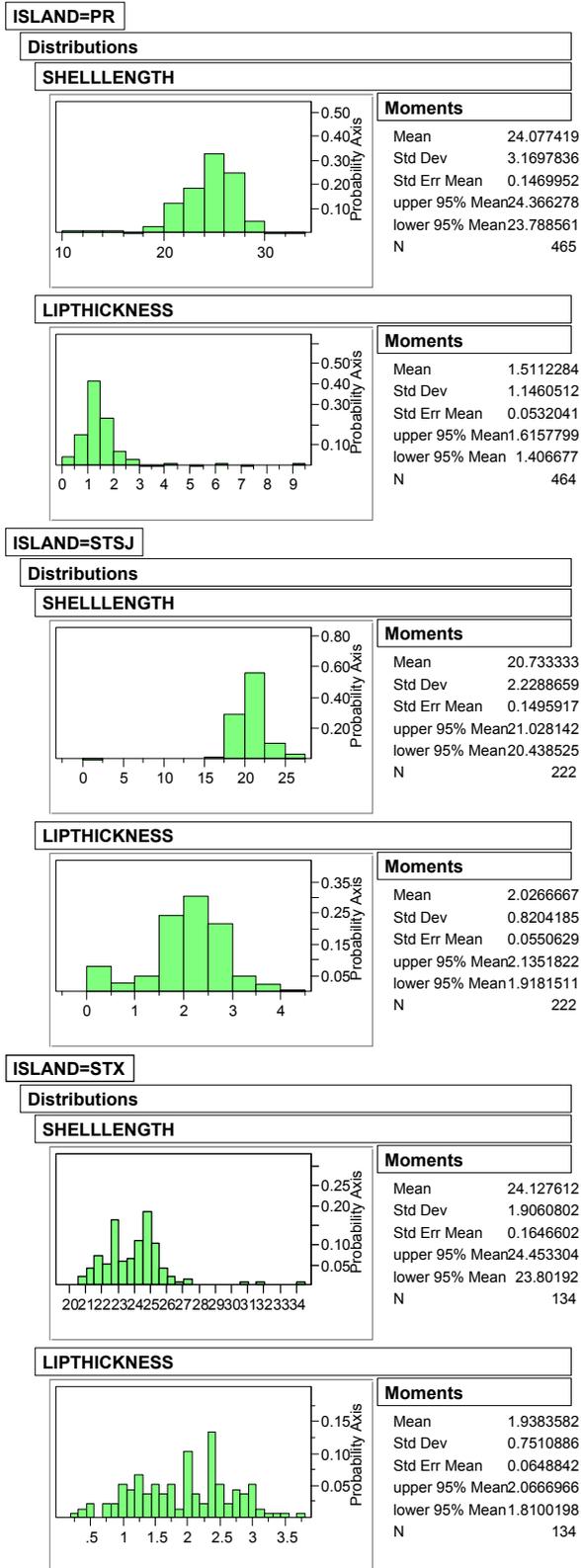


Figure 6. Queen conch shell length and lip-thickness frequency distributions by island: Puerto Rico (PR), St. Thomas-St. John (STSJ), and St. Croix (STX), U.S.V.I. Data source: CFMC/ Rivera (1999).

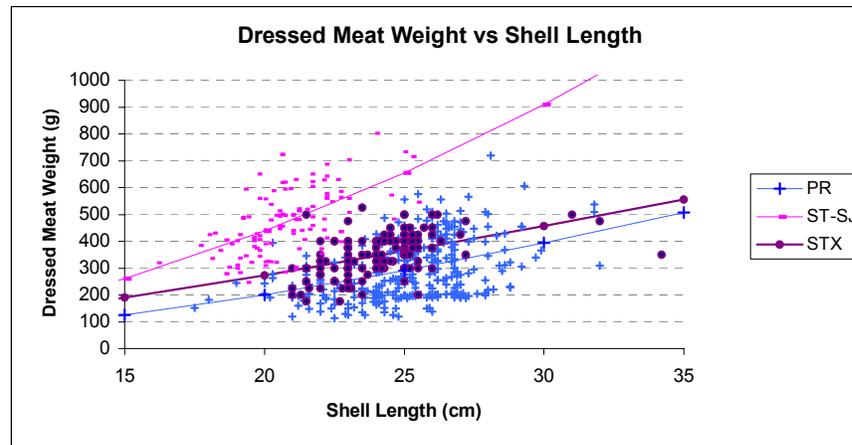
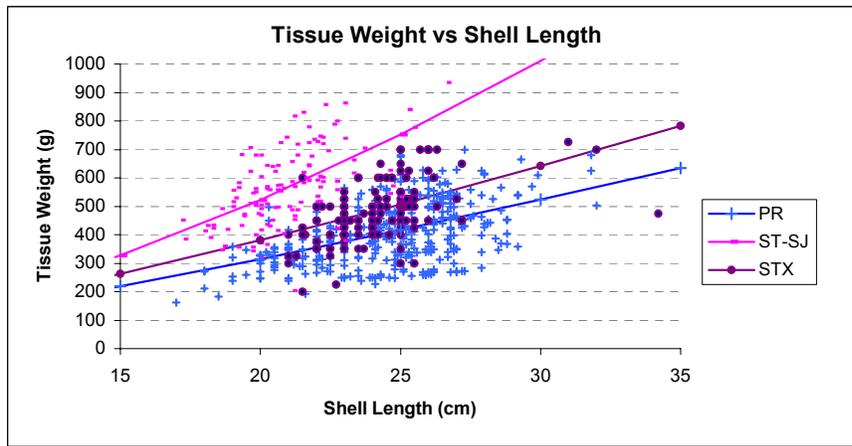
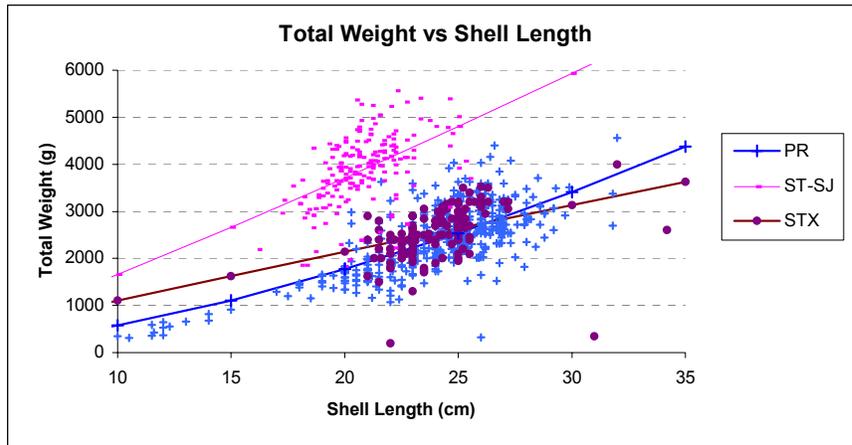
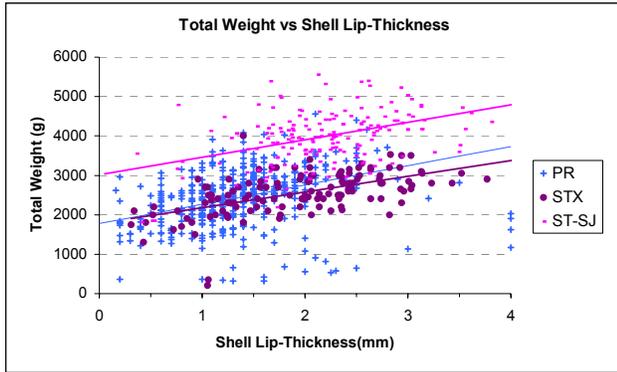


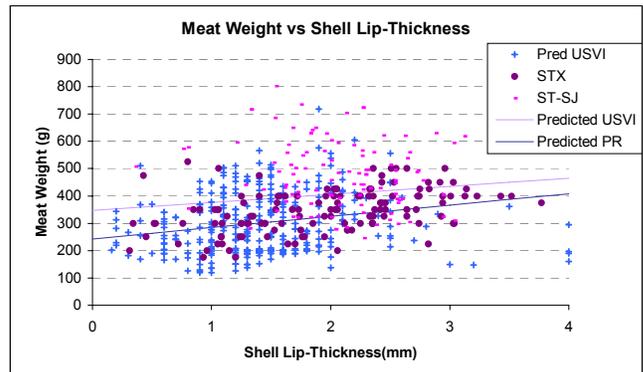
Figure 7. Shell-length-weight relationships of the form $Length = A * Weight^B$ for queen conch by island. Total weight, tissue weight (uncleaned meat) and dressed meat weight functions are shown. Regression parameters are provided in **Table 8**. Data source: CFMC/ Rivera (1999).

(a)



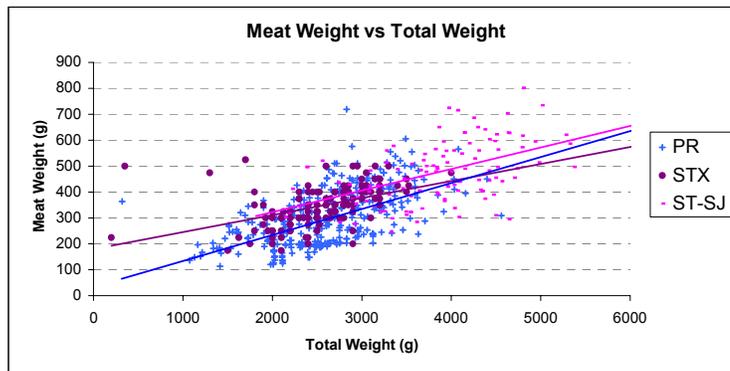
Linear Fits	TOTAL WEIGHT= A+B (Lip-thickness)				
Island	N	R ²	Param.	Estimate	s.e.
PR	445	0.13	A	1779.88	85.15
*(Lips<= 3mm)			B	488.11	60.33
ST-SJ	201	0.33	A	2756.27	122.01
			B	553.57	55.44
STX	134	0.31	A	1778.22	108.48
			B	398.64	52.21

(b)



Linear Fits	MEAT WEIGHT= A+B (Lip-thickness)				
Island	N	R ²	Param.	Estimate	s.e.
PR	321	0.04	A	242.68	16.88
*(Lips<= 3mm)			B	41.33	11.46
U.S.V.I.	243	0.03	A	346.71	24.35
(ST-SJ/STX pooled)			B	29.64	11.61

(c)



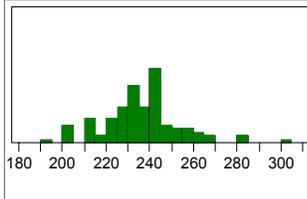
Linear Fits	MEAT WT= A+B (TOTAL WT)				
Island	N	R ²	Param.	Estimate	s.e.
PR	341	0.31	A	34.72	21.54
			B	0.10	0.01
ST-SJ	120	0.24	A	155.11	53.20
			B	0.08	0.01
STX	134	0.21	A	179.11	29.03
			B	0.07	0.01

Figure 8. Linear fits by island of (a) Shell-lip-thickness-Total weight; (b) Lip-thickness-Dressed meat weight. Data for PR was restricted to Lip <=3mm; data from ST-SJ and STX were pooled for improved fits. (c) Dressed meat weight –total weight. Regression parameters are provided in the tables above. Data source: CFMC/Rivera (1999).

Area=C-2

Distributions

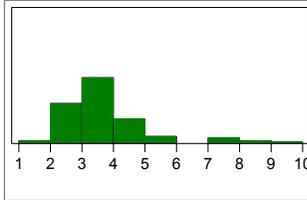
ShellLength



Moments

Mean	234.24
Std Dev	18.007922
Std Err Mean	1.8007922
upper 95% Mean	237.81316
lower 95% Mean	230.66684
N	100

Lip Thickness



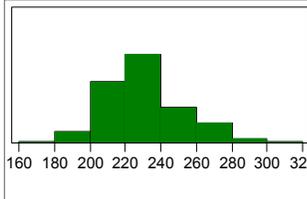
Moments

Mean	3.693
Std Dev	1.4848906
Std Err Mean	0.1484891
upper 95% Mean	3.9876345
lower 95% Mean	3.3983655
N	100

Area=C-4

Distributions

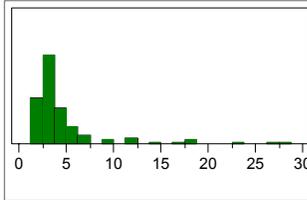
ShellLength



Moments

Mean	228.28
Std Dev	23.17177
Std Err Mean	2.317177
upper 95% Mean	232.87778
lower 95% Mean	223.68222
N	100

Lip Thickness



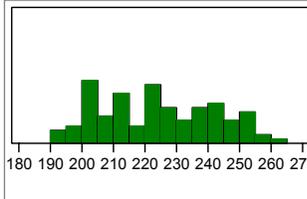
Moments

Mean	5.1050505
Std Dev	4.9340213
Std Err Mean	0.4958878
upper 95% Mean	6.0891237
lower 95% Mean	4.1209773
N	99

Area=C-5

Distributions

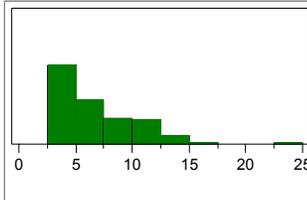
ShellLength



Moments

Mean	221.92
Std Dev	18.213482
Std Err Mean	1.8213482
upper 95% Mean	225.53395
lower 95% Mean	218.30605
N	100

Lip Thickness



Moments

Mean	6.907
Std Dev	3.6578753
Std Err Mean	0.3657875
upper 95% Mean	7.6328018
lower 95% Mean	6.1811982
N	100

Figure 9. Queen conch size frequency distributions by area in St. Croix, U.S. Virgin Islands. Data source: CFMC /Tobias (1987).

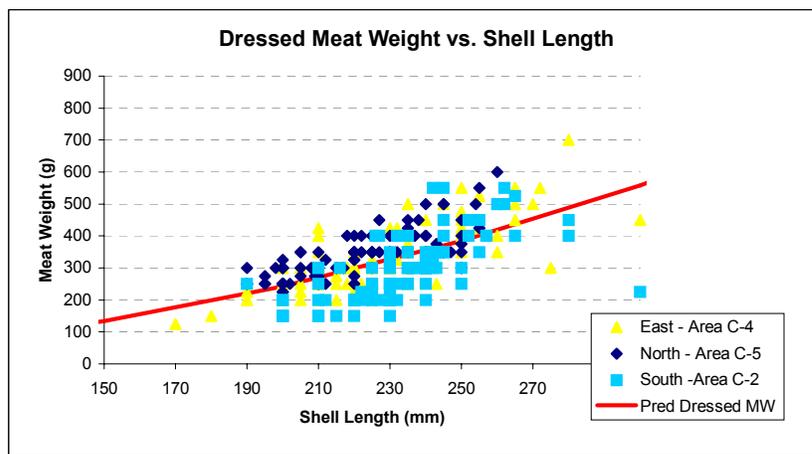
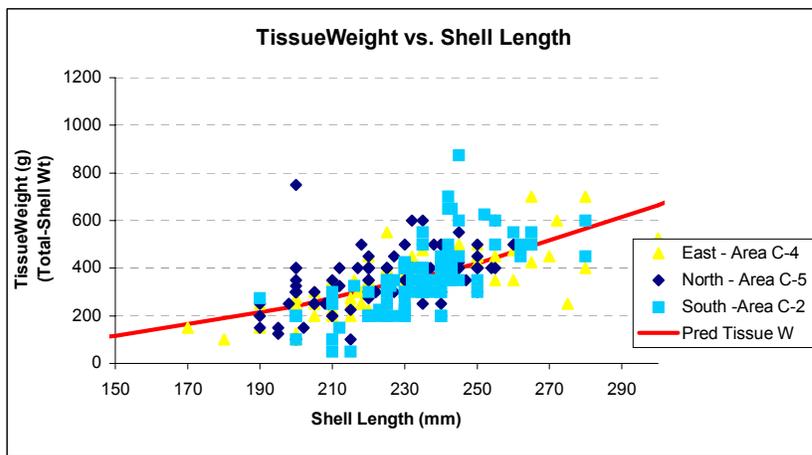
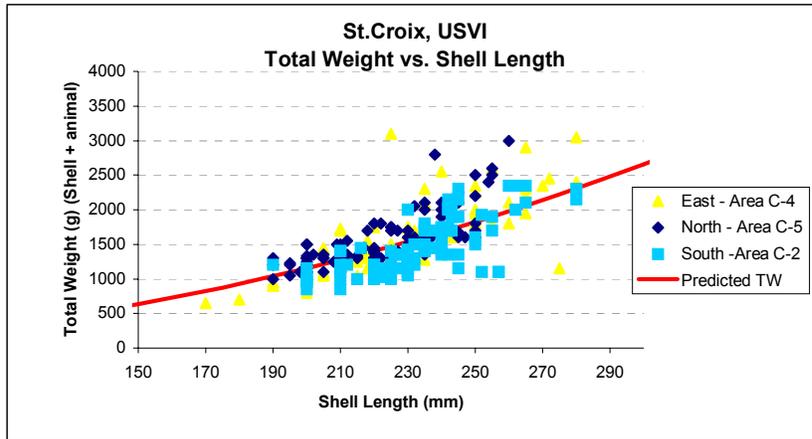


Figure 10. Shell-length vs. weight relationships of the form $Length = A * Weight^B$ for queen conch in St. Croix, U.S.V.I. Total weight, tissue weight (total wt minus shell wt) and dressed meat weight functions are shown by area. Data points are plotted by area (East, North and South). Regression parameters are provided in **Table 9**. Data sources: CFMC Conch Project/ Tobias (1986).

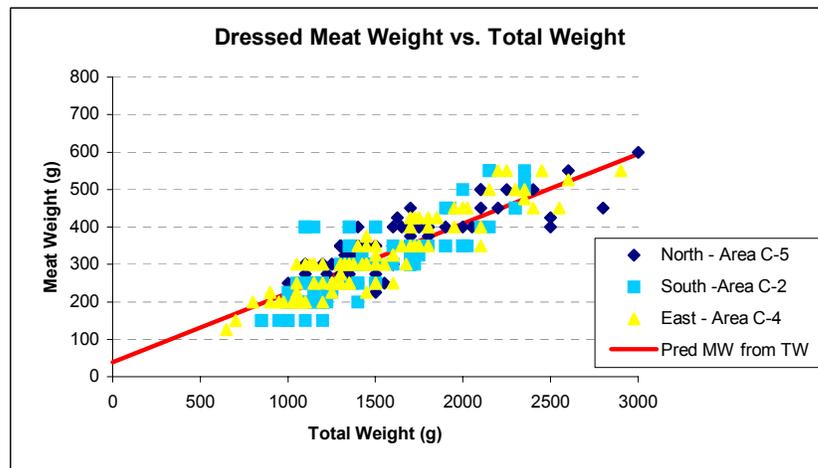
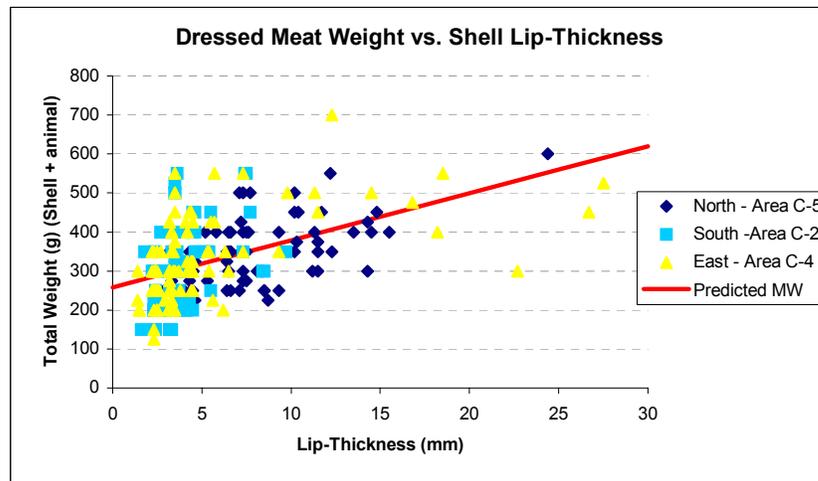
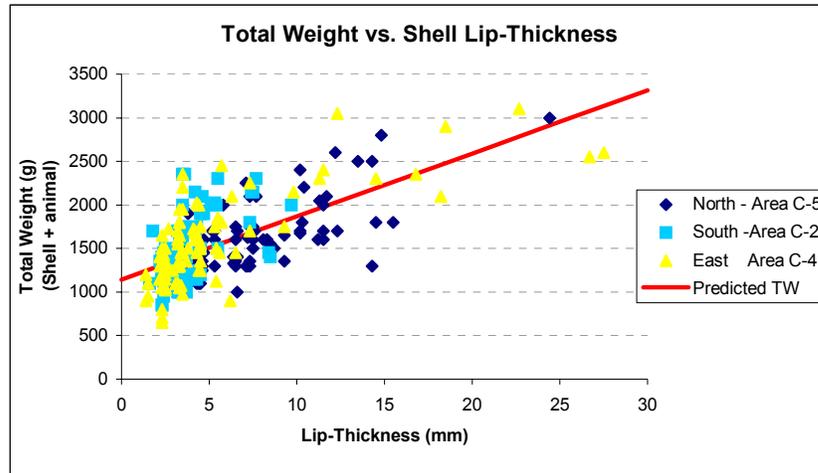


Figure 11. Linear fits of lip-thickness and weight for queen conch in St. Croix. Data points are plotted by area. Data source: CFMC Conch Project/ Tobias (1986).

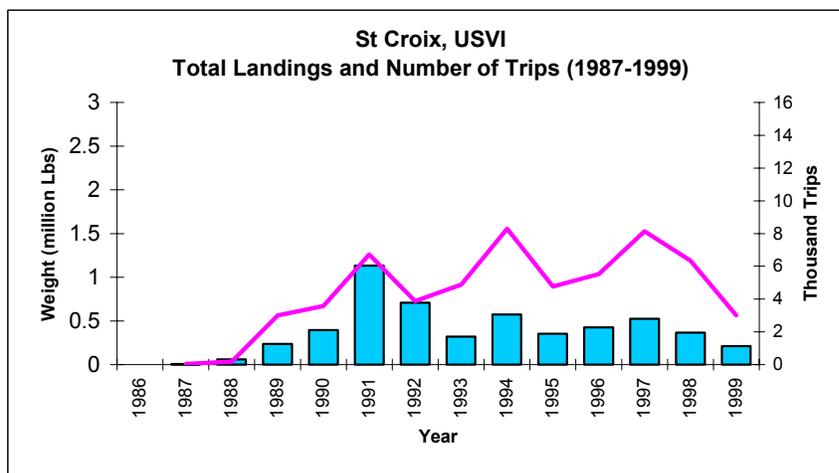
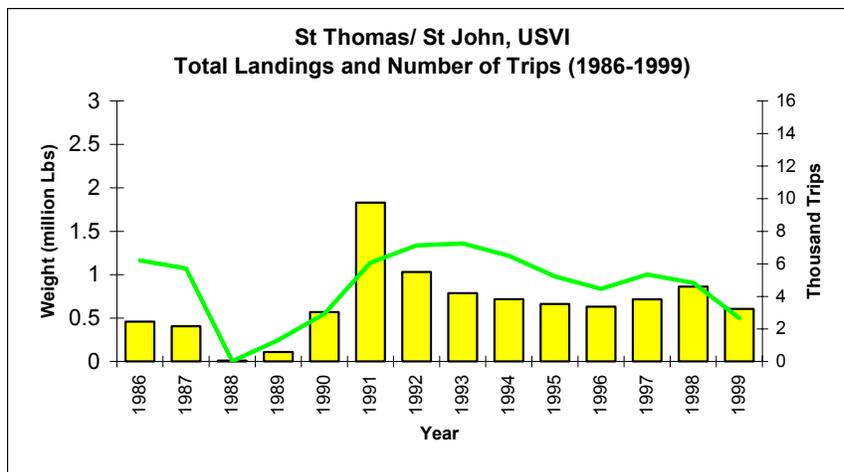
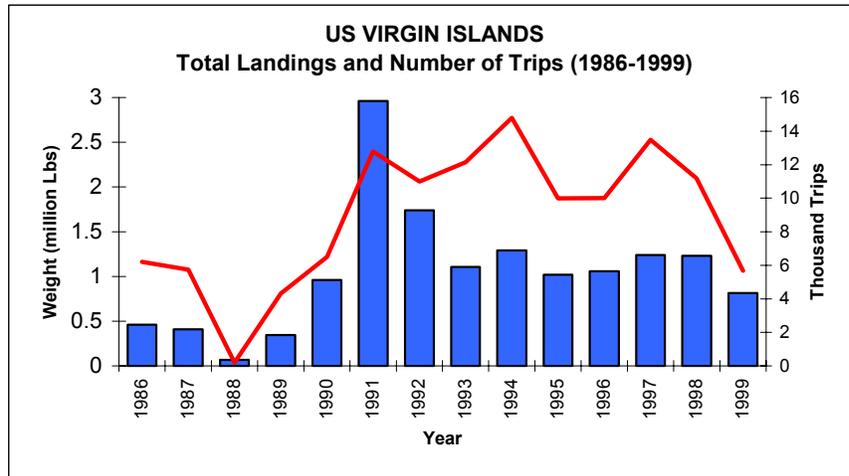


Figure 12. Total estimated landings and number of trips for the combined multi-species fishery of the U.S. Virgin Islands (1986-1999). Trends are shown for all the islands combined and for St. Thomas/St. John and St. Croix.

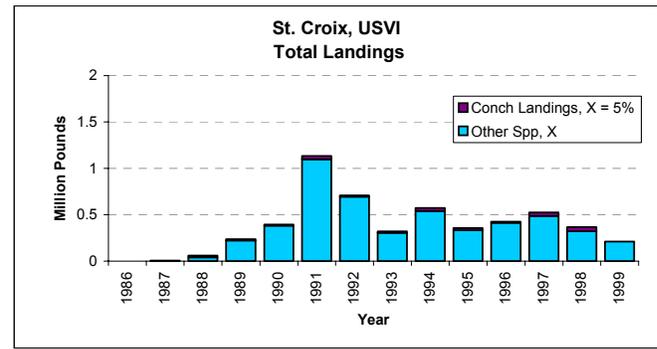
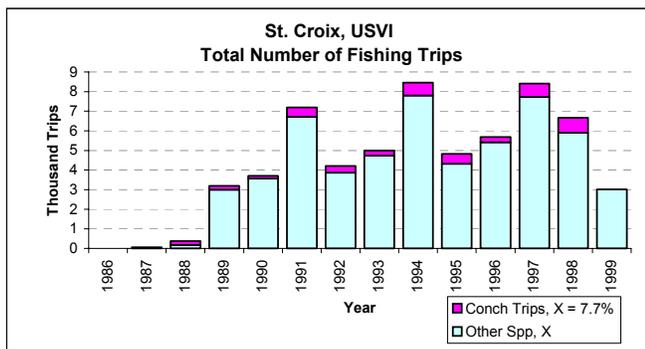
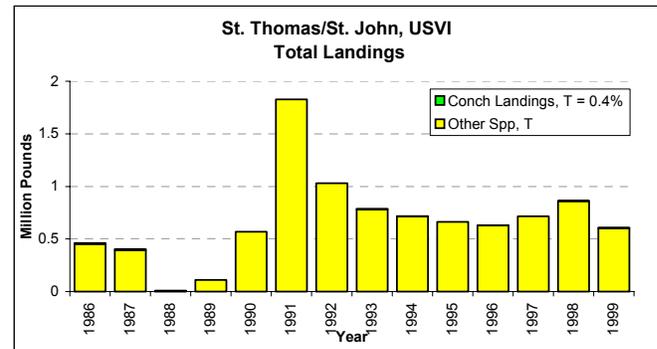
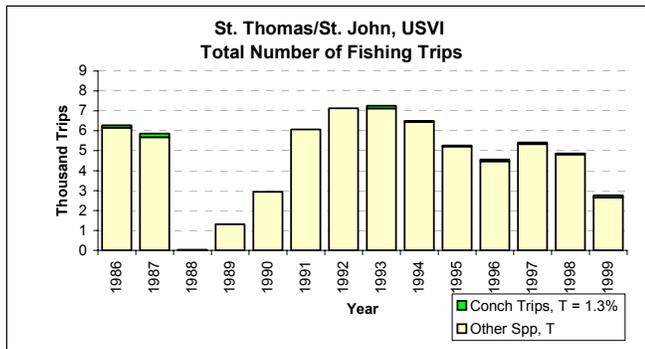
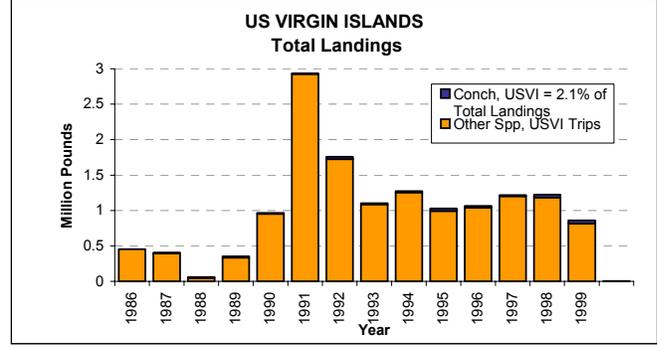
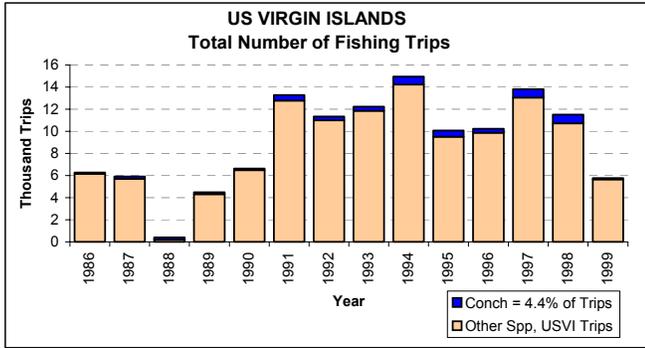
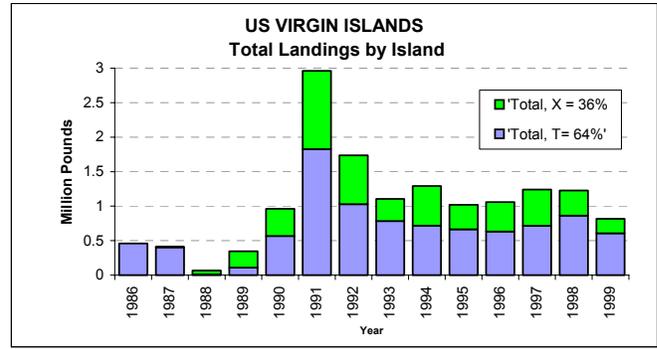
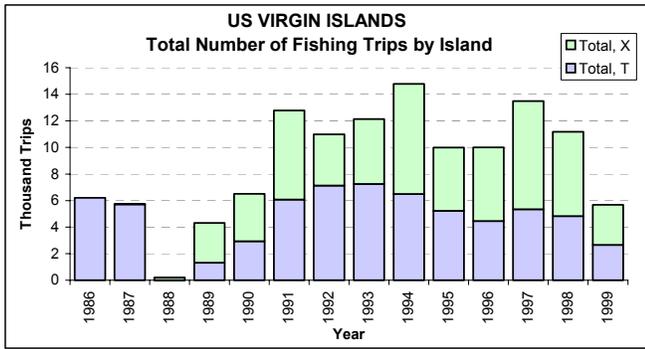


Figure 13. Estimated total, queen conch and other species landings and number of trips in the U.S. Virgin Islands (1986-1999). USVI= All islands combined; T= St. Thomas/St. John, X= St. Croix. The graphs on the left panel show the number of trips, the graphs on the right panel show the estimated landings. The proportions (%) by island and the proportion of queen conch landings and trips are provided.

U.S. VIRGIN ISLANDS Catch Composition by Island (FY 1986-1999)

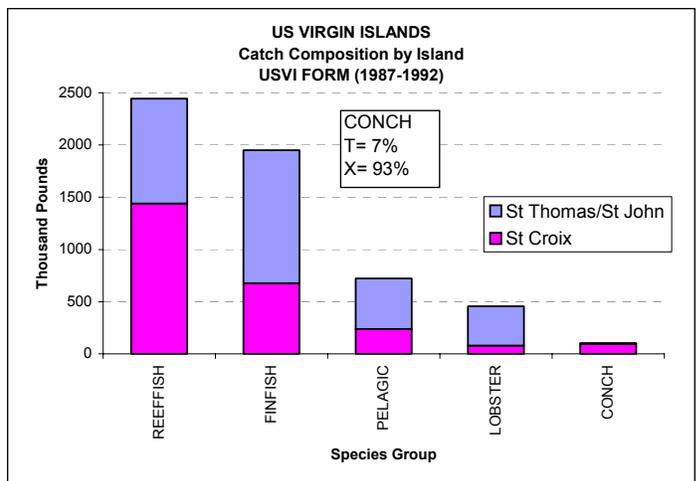
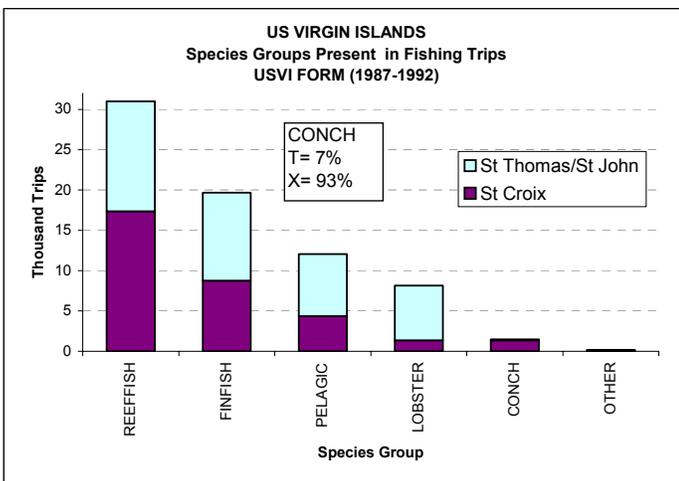
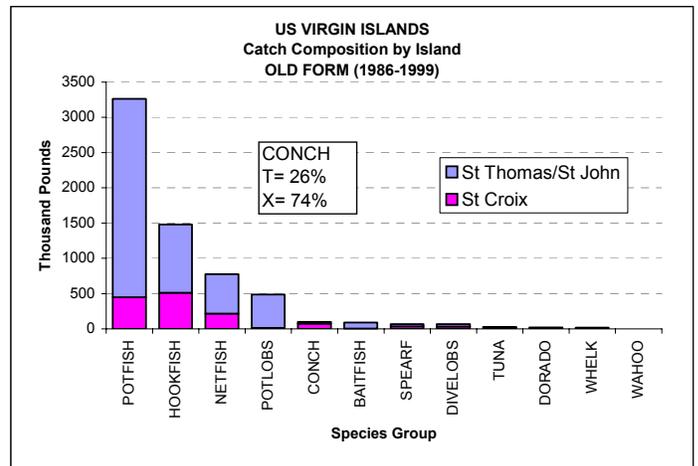
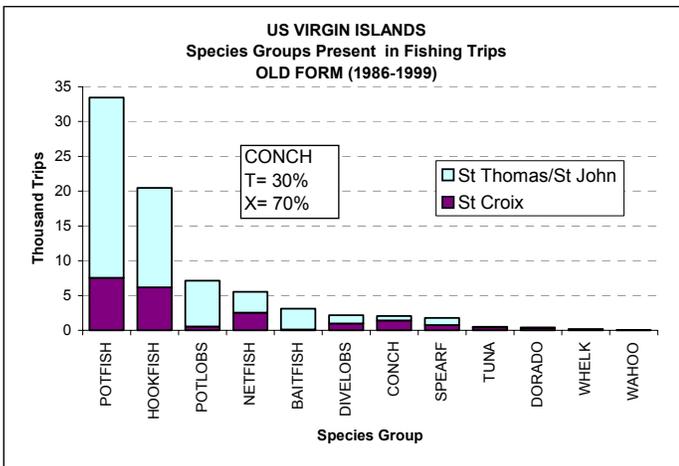
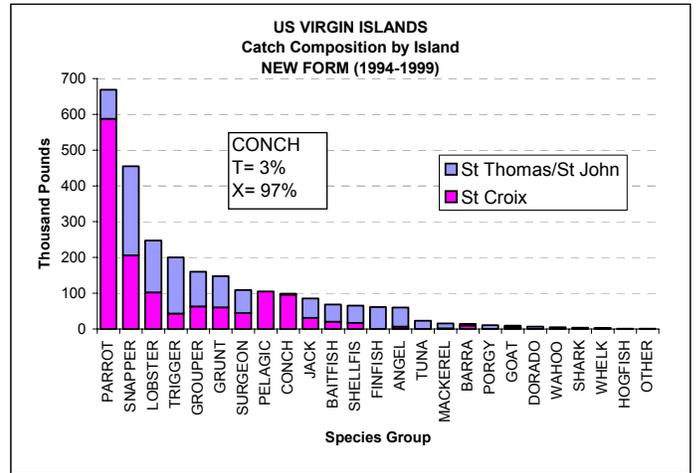
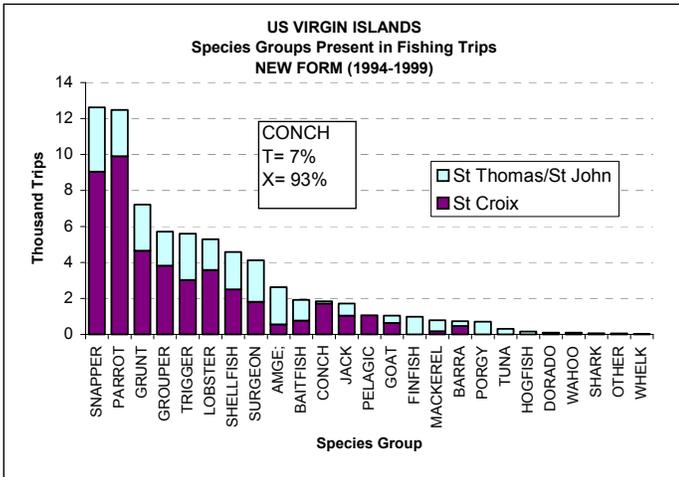


Figure 14. U.S. Virgin Islands. Catch composition by island and by trip-ticket format between fishing years 1986-1999. The data were aggregated for those years when each format was used. The graphs on the left panel show the proportion of the trips where each species or species group was present; the graphs on the right panel show the proportion of the landings. The percentage of the conch trips and landings by island are given. T= St. Thomas/St. John; X= St. Croix.

U.S. VIRGIN ISLANDS
Species Associated to the Queen Conch Fishery (FY 1996-1999)
(NEW FORM)

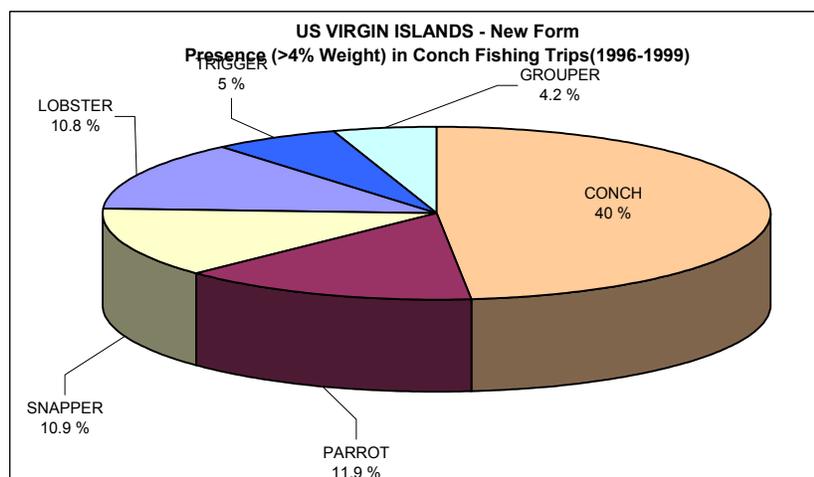
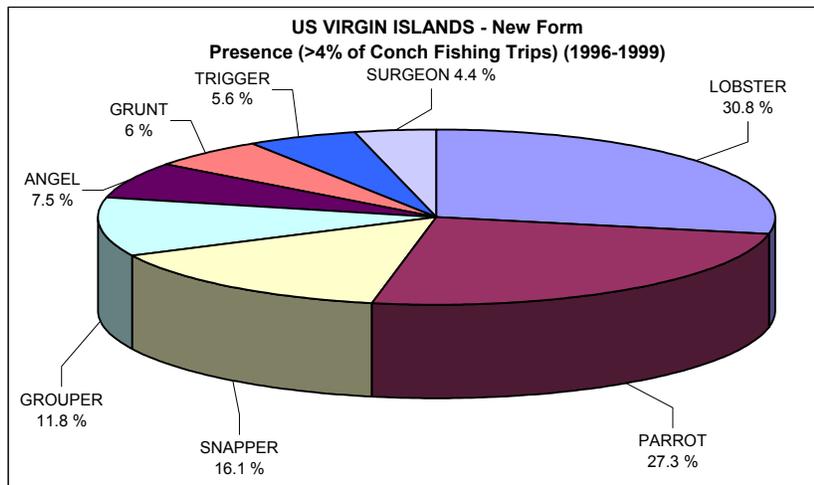
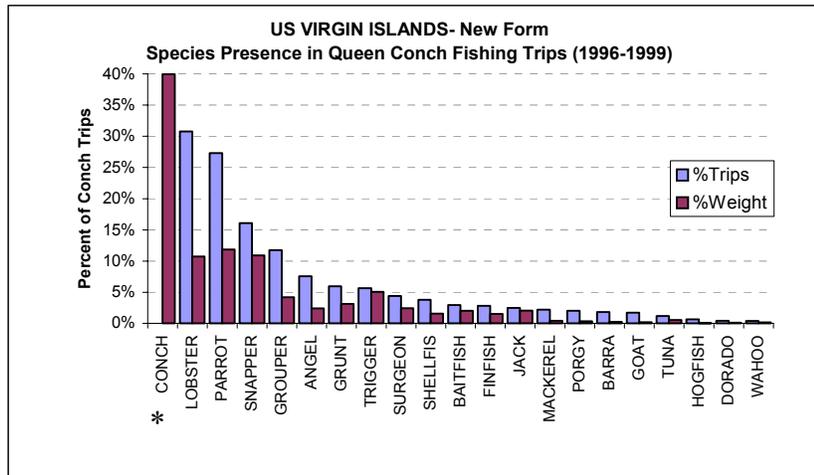


Figure 15. (a) U.S. Virgin Islands, New Form. Species groups represented (>2% presence) in positive queen conch fishing trips (1996-1999). The first graph shows both the proportion (%) of trips and of total landings represented by each species group. (*) By definition, the % of trips with conch present in positive conch trips is 100%, so the corresponding bar is not shown. The pie charts are alternative representations, where the proportion of trips and the proportion of the total weight landed in conch trips are shown separately.

U.S. VIRGIN ISLANDS
Species Associated to the Queen Conch Fishery (FY 1987-1992)
(USVI FORM)

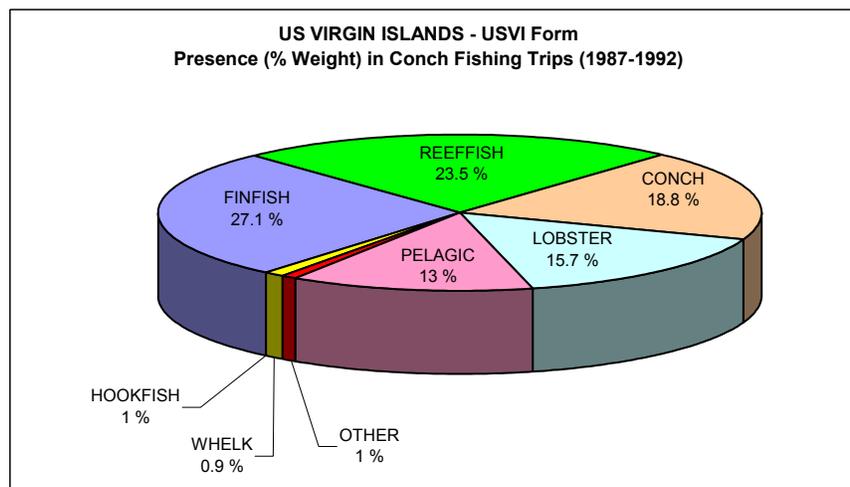
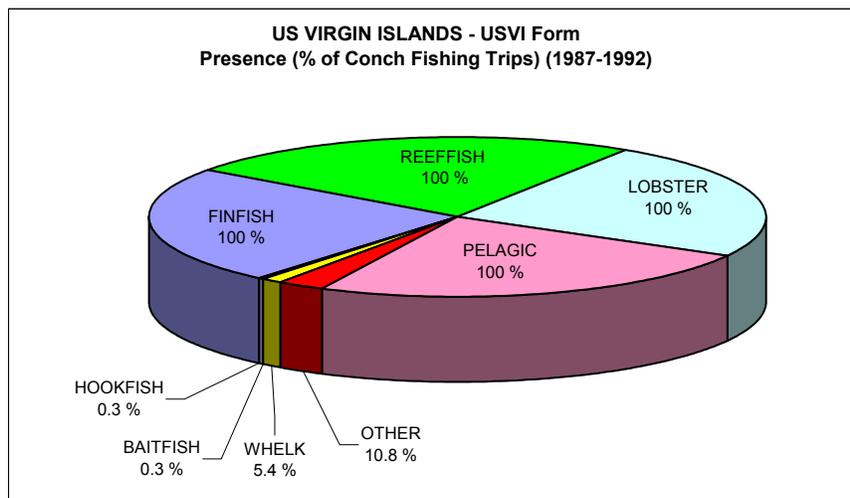
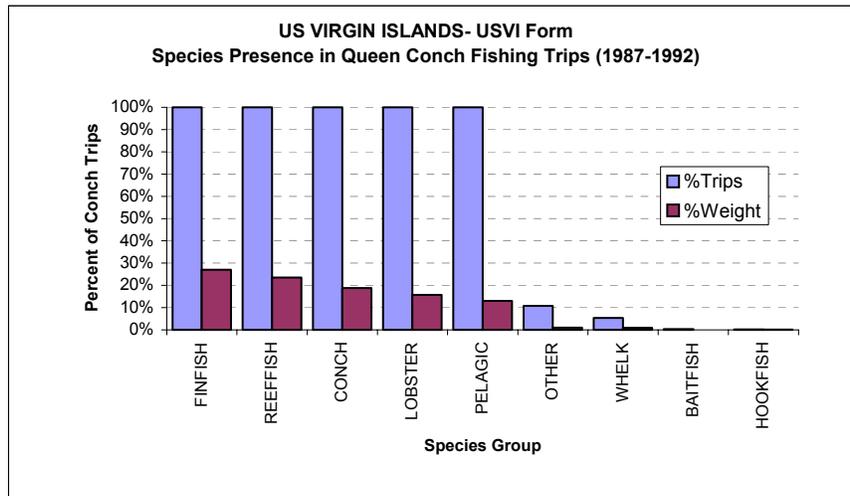


Figure 15. (b) U.S. Virgin Islands, USVI Form. Species groups represented in positive queen conch fishing trips (1987-1992). The proportion of trips and of total landings represented by each species group are provided.

U.S. VIRGIN ISLANDS
Species Associated to the Queen Conch Fishery (FY 1986-1999)
(OLD FORM)

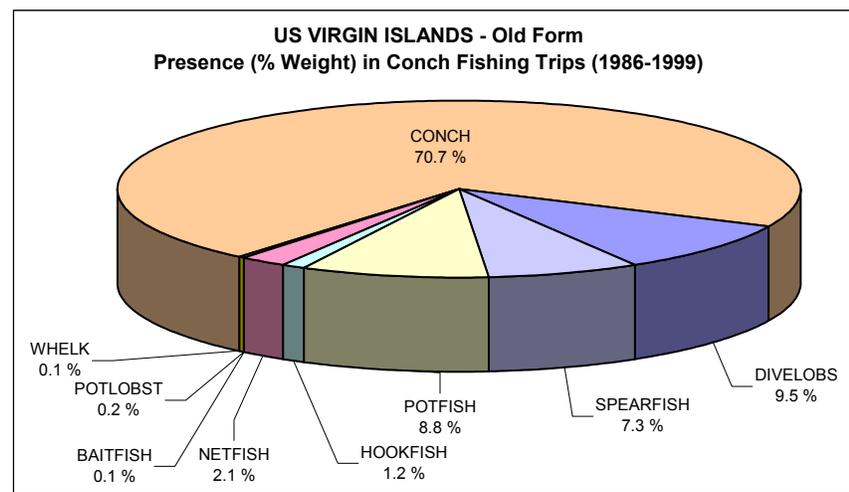
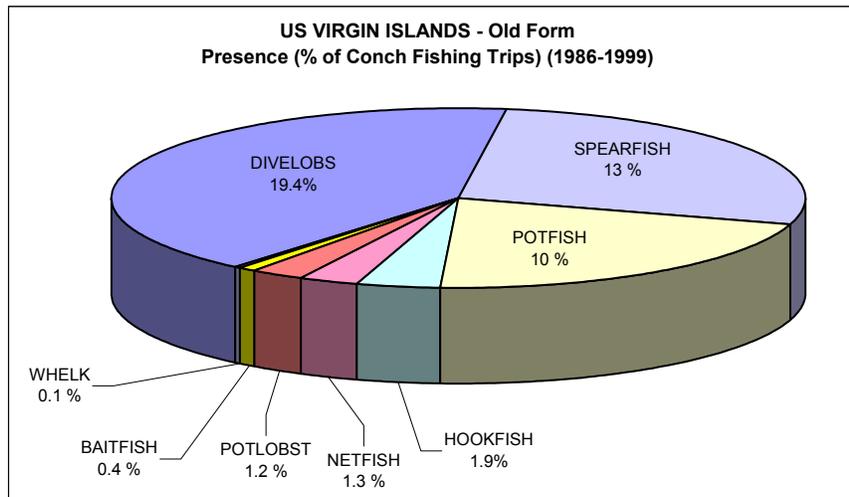
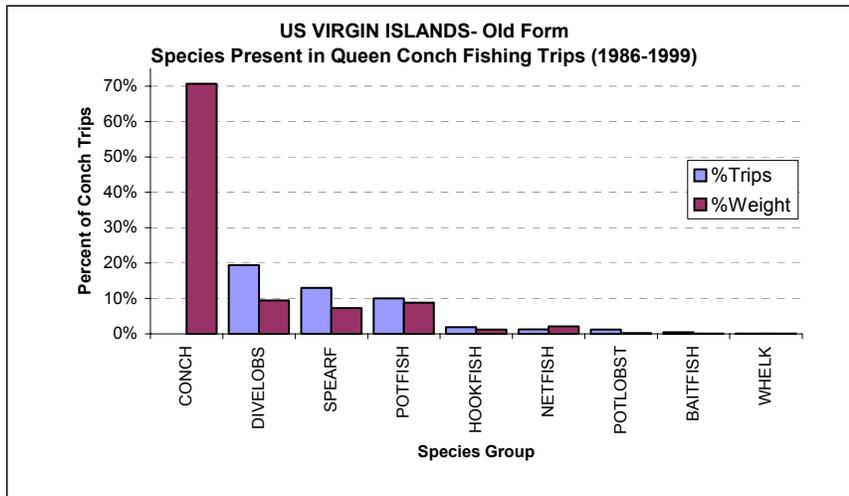


Figure 15. (c) U.S. Virgin Islands, Old Form. Species groups represented in positive queen conch fishing trips (1986-1999). The proportion of trips and of total landings represented by each species group are provided.

U.S. VIRGIN ISLANDS Species Associated to the Queen Conch Fishery by Island

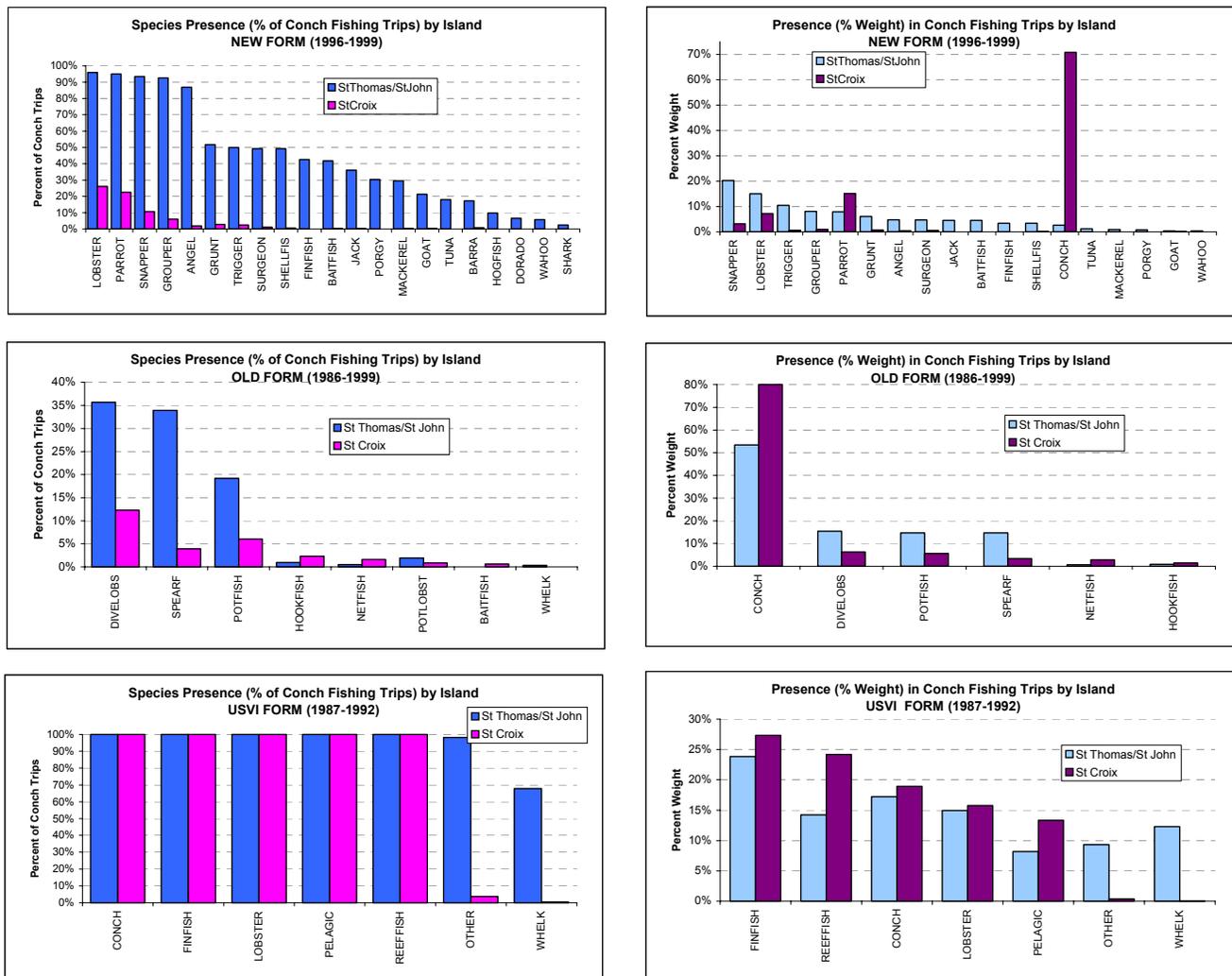
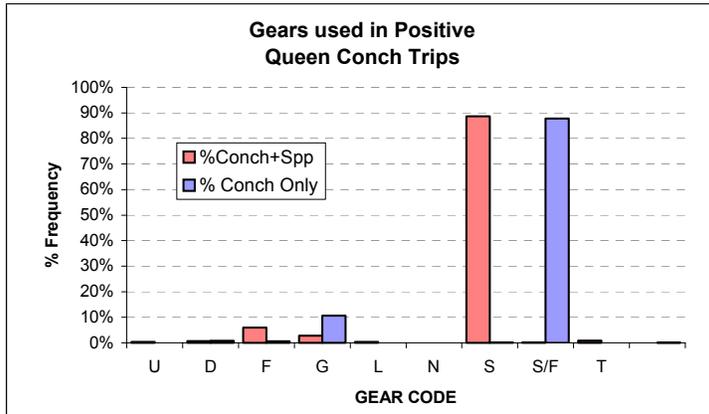


Figure 15. (d) U.S. Virgin Islands. Species groups represented in the positive queen conch fishing trips (1986-1999) by island and by trip-ticket format. The proportion of trips and of total landings represented by each species group are provided.

U.S. VIRGIN ISLANDS (New Format 1996-1999)
Gears Used and Time Fishing



Code	Gear Type
U	Unknown
D	Diving
N	Net
G	Gill net
N	Siene net
F	Free diving
S	Scuba
T	Trap
L	Line fishing
S, F	Scuba diving and free diving

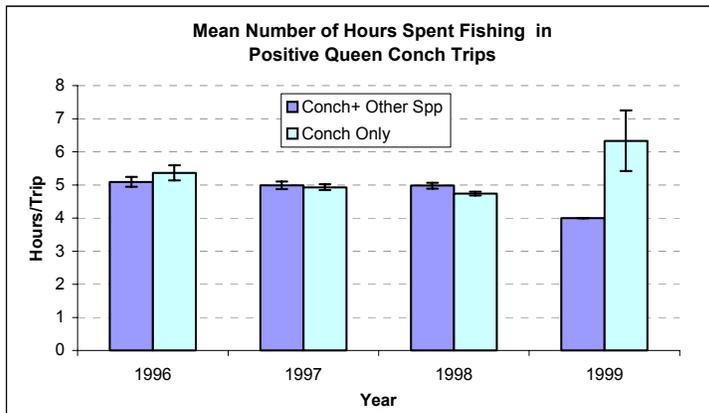
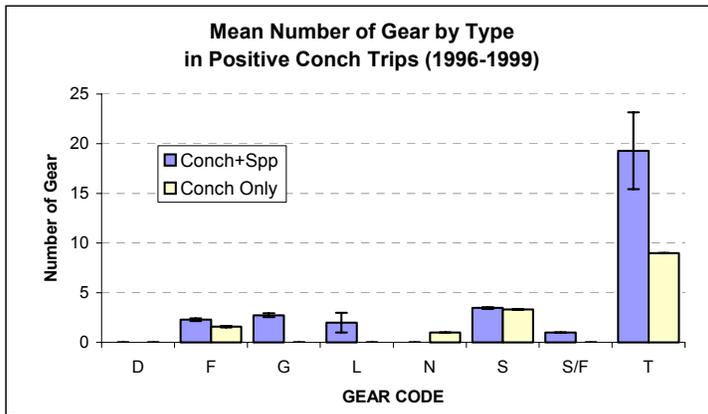


Figure 16. U.S. Virgin Islands. Gears used and time spent fishing in positive queen conch fishing trips. Data were taken only from records in the new trip-ticket format (1996-1999). Other formats did not contain detailed information of this type.

U.S. VIRGIN ISLANDS
Mean Annual Trips and Landings by Fishing Area and Island (1986-1999)

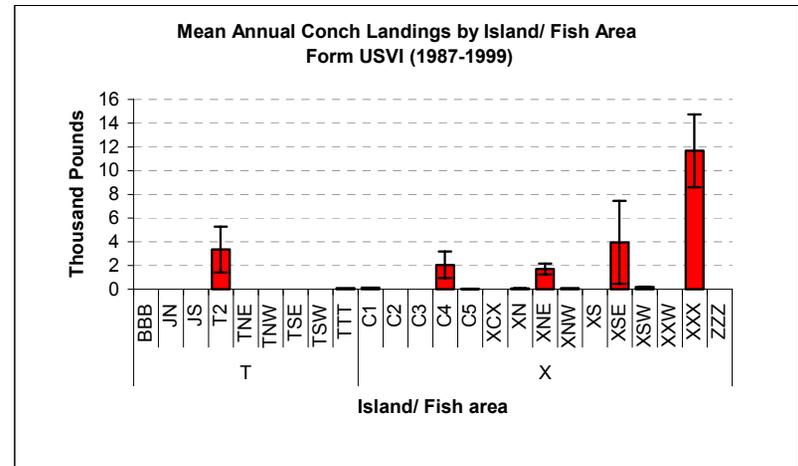
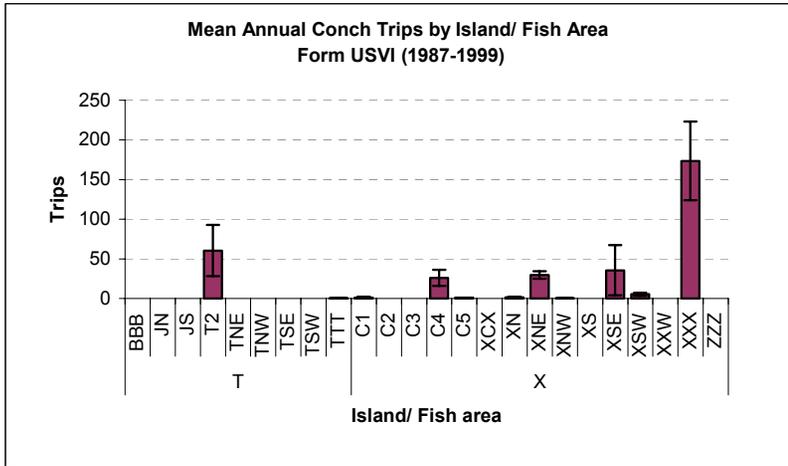
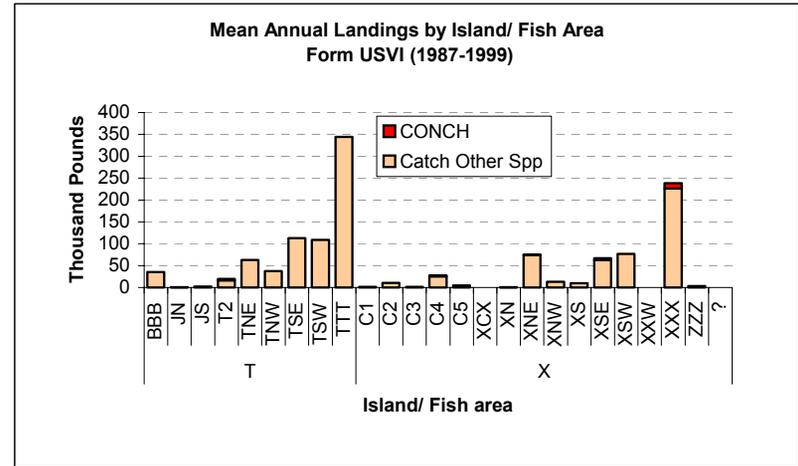
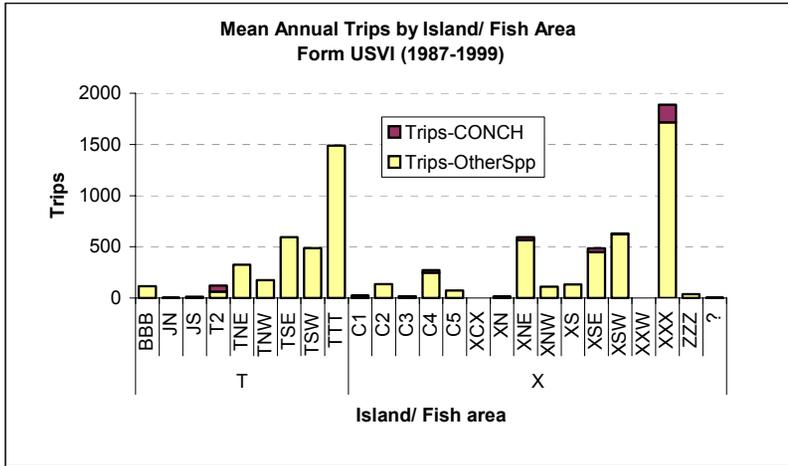


Figure 17. Estimated mean annual landings and mean number of fishing trips by island and area for years 1986-1999. Trips-conch are trips where conch was present (conch-positive trips); Trips-Other species are trips where conch was not present. The graphs in the bottom panel show only conch trips and conch landings, respectively. Area codes are given in Appendix A.

U.S. VIRGIN ISLANDS Summary of the Queen Conch Landings Statistics (1986-1999)

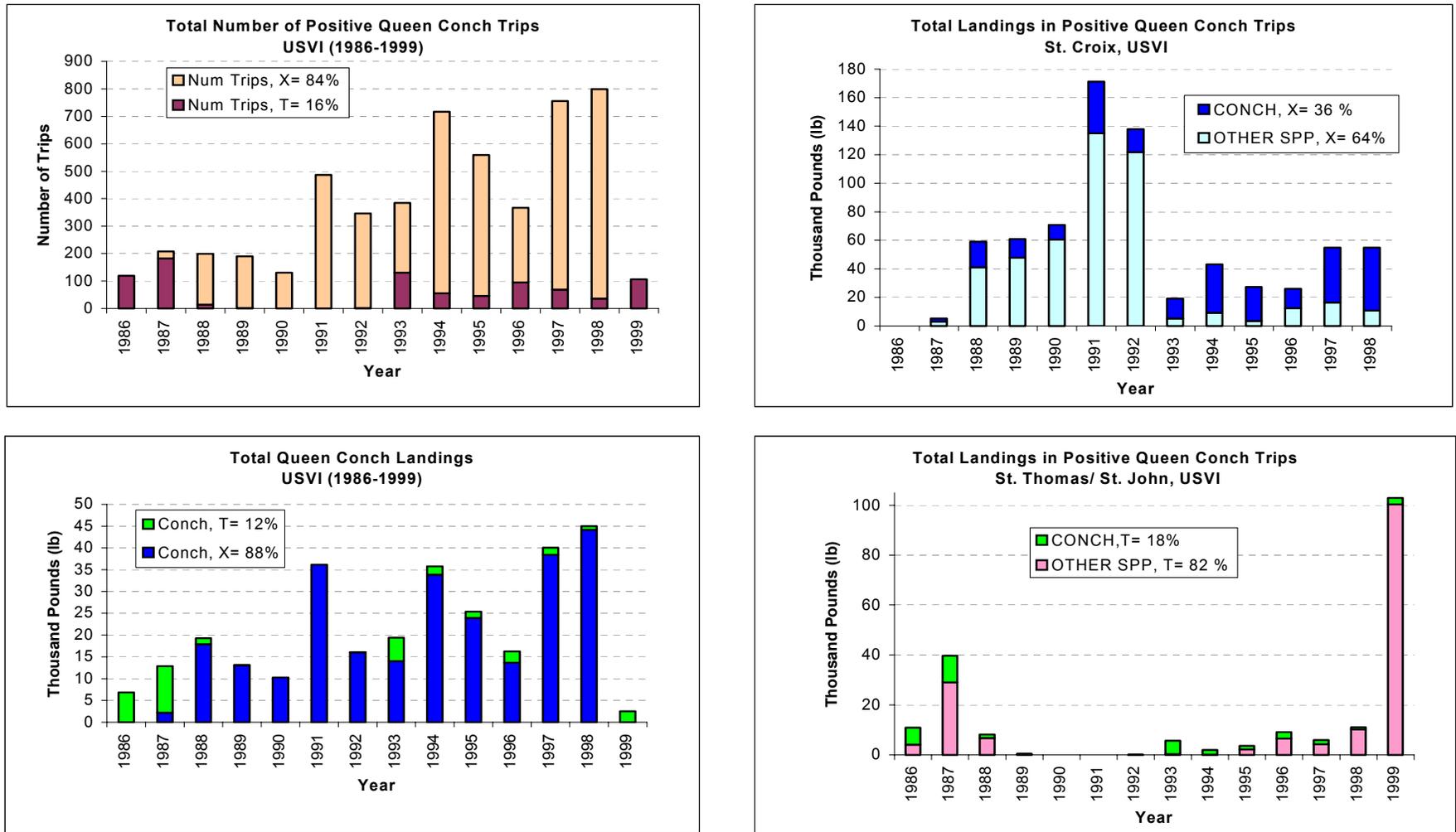


Figure 18. U.S. Virgin Islands (1986-1999). Estimated landings and number of trips by island in positive queen conch trips. The graphs on the left panel show the proportions of the total by island; the graphs on the right show the proportion of conch trips and landings within each island. T= St. Thomas/St. John, X=St. Croix.

Summary of the Queen Conch Landings Statistics (1986-1999)

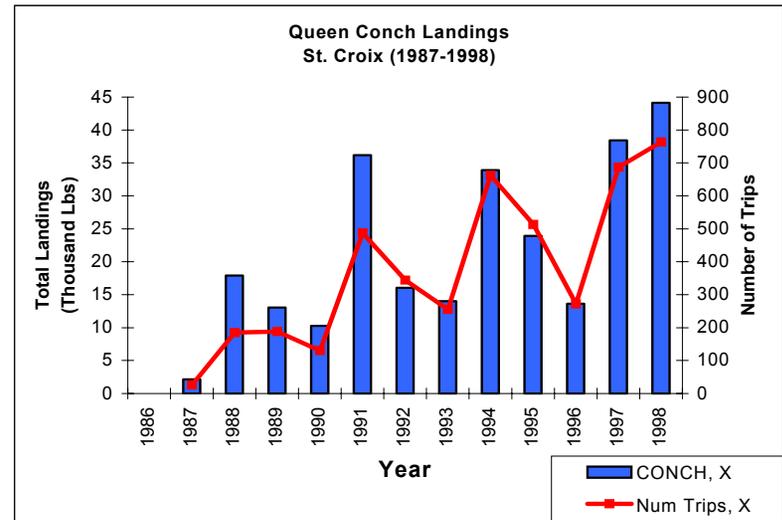
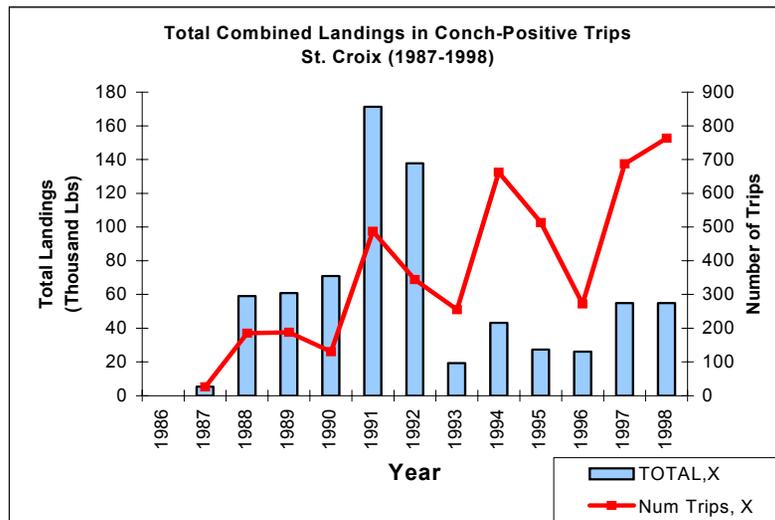
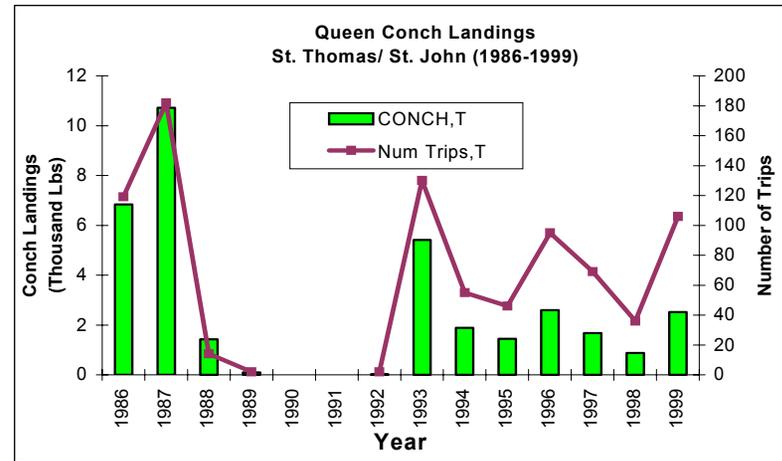
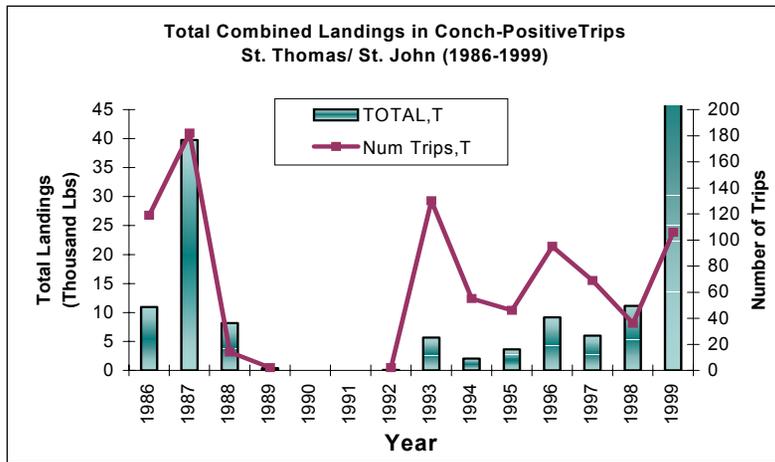


Figure 19. U.S. Virgin Islands (1986-1999). Estimated total combined and queen conch landings in positive conch trips. The top panel corresponds to the islands of St. Thomas/St. John (T); the bottom to St. Croix (X). The bars represent landings; the lines represent the number of trips.

U.S. VIRGIN ISLANDS
Monthly Trends in Catch and Effort Statistics

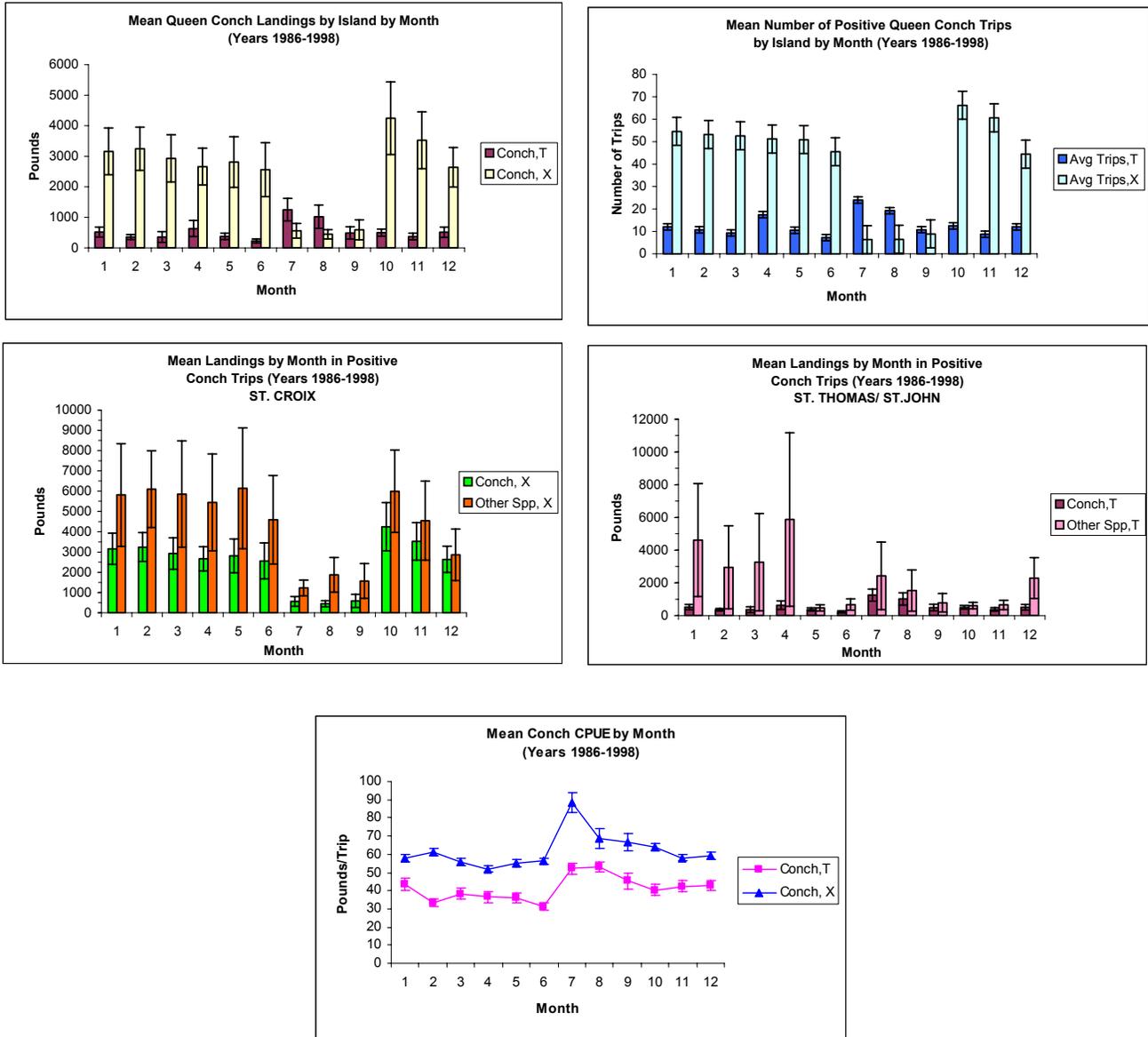


Figure 20. U.S. Virgin Islands. Estimated mean monthly landings (in positive conch trips) and number of positive conch trips by island (T= St. Thomas/St. John; X= St. Croix). Years 1986-1998 were combined. The bottom figure shows the mean nominal conch catch rates by month and by island. Error bars are standard errors of the estimates.

U.S. VIRGIN ISLANDS Nominal Catch Rates by Island

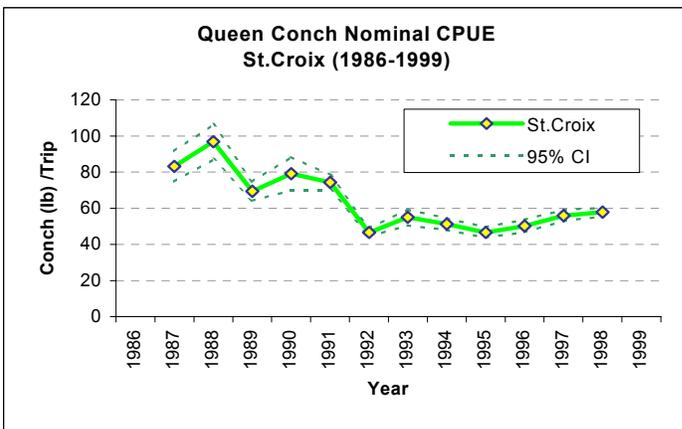
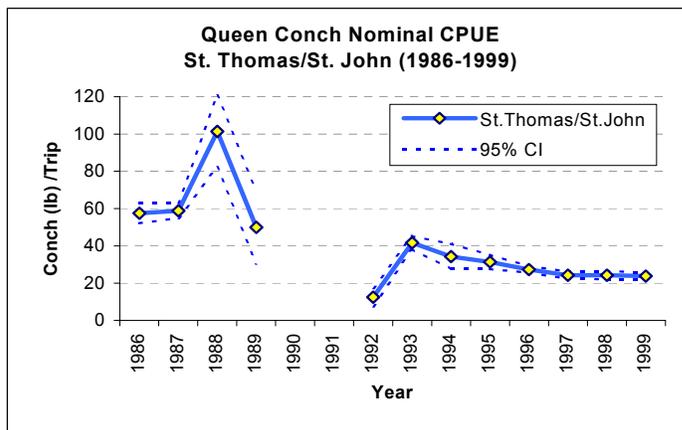
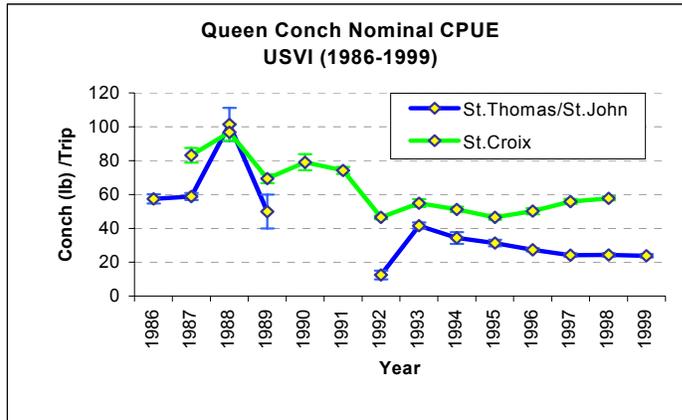


Figure 21 (a). U.S. Virgin Islands. Estimated nominal queen conch catch rates by island (T= St. Thomas/St. John; X= St. Croix) for years 1986-1999. Solid lines are mean values; dotted lines represent 95% confidence intervals.

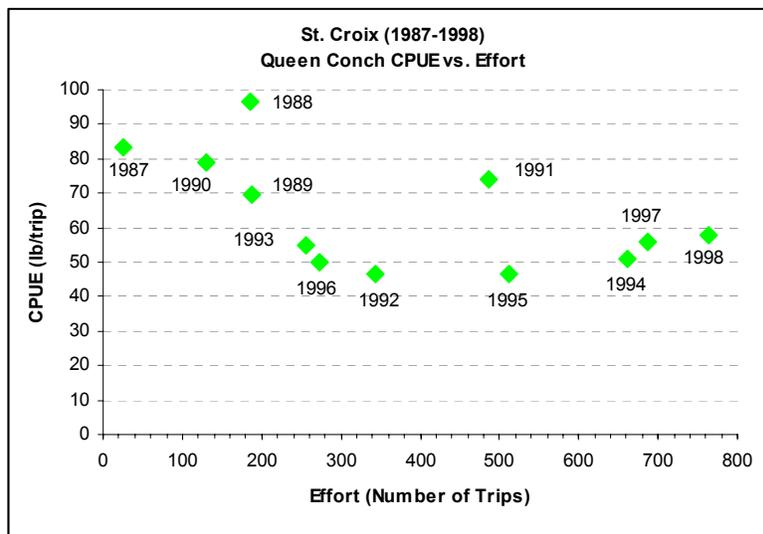
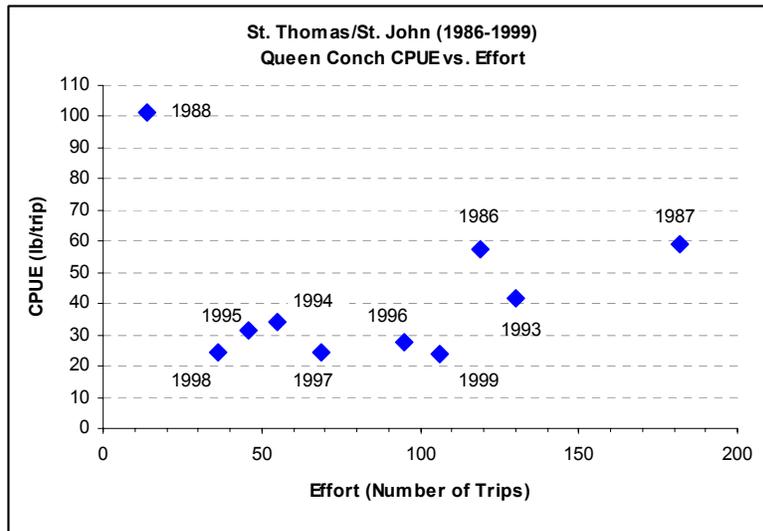


Figure 21 (b). Nominal catch rates (lb/trip) versus effort (number of positive queen conch trips) by island. All the positive conch trips were considered and the CPUEs are for the whole fishery (not by sector).

U.S. VIRGIN ISLANDS
Summary Statistics for the Directed/Non-Directed Sectors of the Queen Conch Fishery

St. Thomas/ St. John

St. Croix

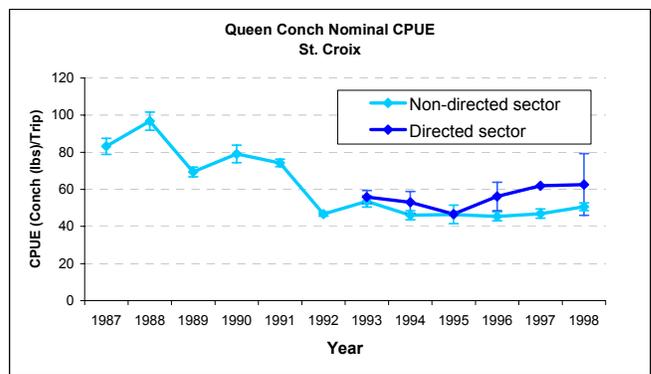
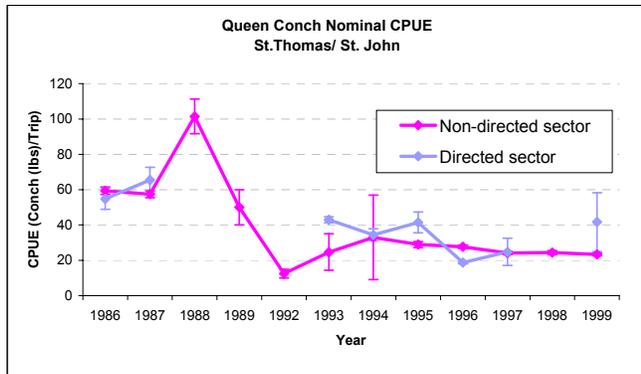
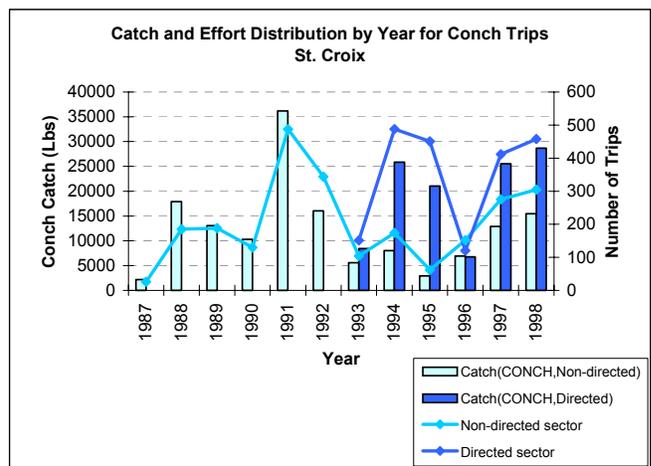
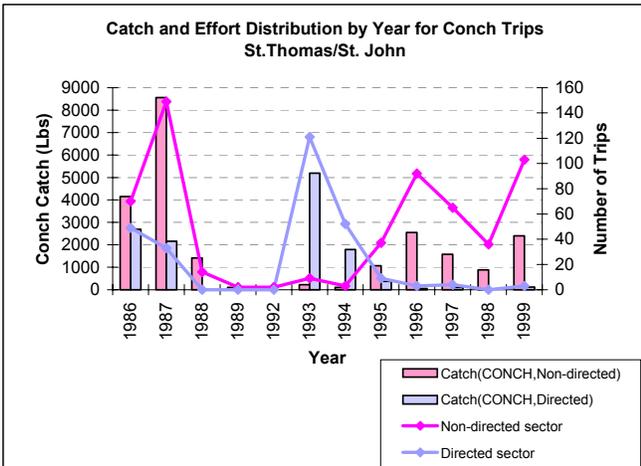
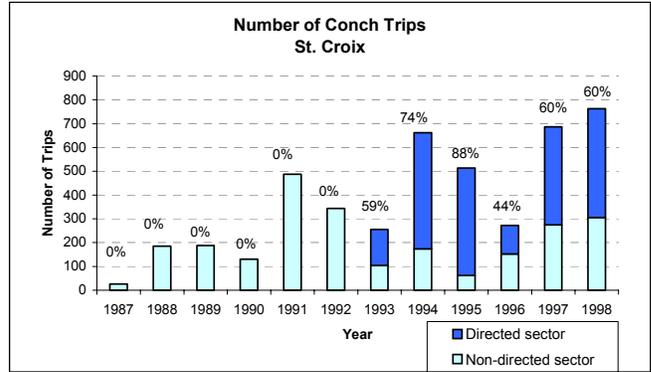
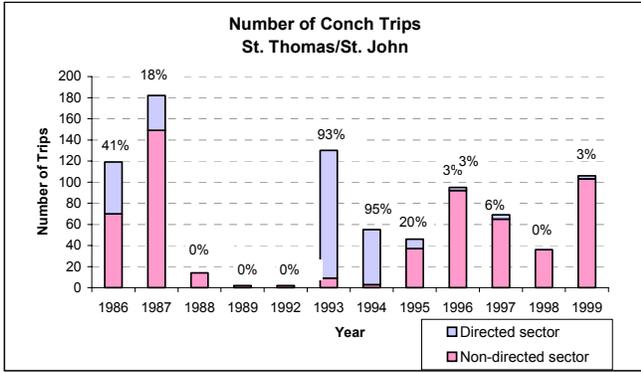
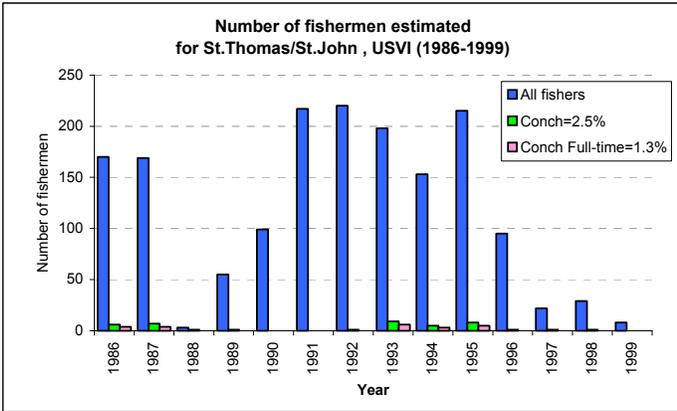


Figure 22. U.S. Virgin Islands. Number of trips, landings and nominal catch rates for the directed and non-directed sectors of the queen conch fishery. Estimates are given by island for years 1986-1999. The graphs on the left correspond to St. Thomas/St. John, the ones on the right to St. Croix. Error bars in CPUEs are standard errors.

U.S. VIRGIN ISLANDS
Estimation of "Full-Time" Conch Fishermen from the Landings Statistics Data Base

St. Thomas/ St. John



St. Croix

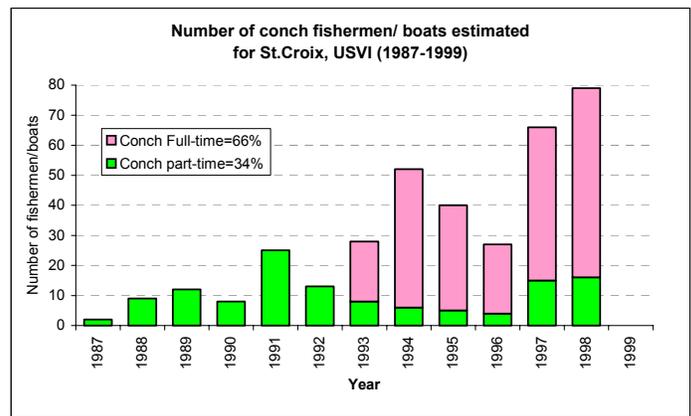
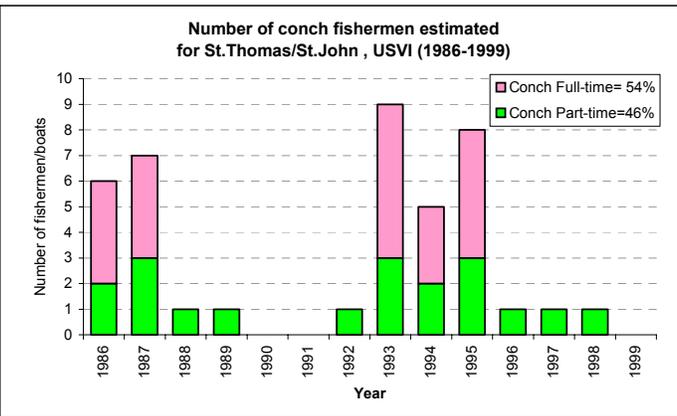
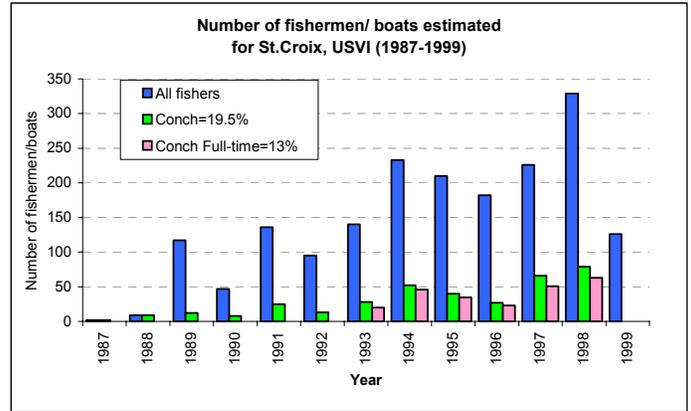


Figure 23. U.S. Virgin Islands. Proportion of “full-time” and “part-time” fishermen by island and year. Definitions are given in the text. The figures in the top panel show the proportions of fishermen that targeted conch exclusively from ALL fishermen. The figures at the bottom show the proportions of “full-time” and “part-time” CONCH fishermen. Note that the trip-ticket format in St. Croix changed in 1993, from reporting Fishermen IDs to Boat IDs. Both identifiers could not be linked in the present study, but were assumed to be equivalent.

U.S. CARIBBEAN
Estimation of "Full-Time" Conch Fishermen from the Landings Statistics Data Base

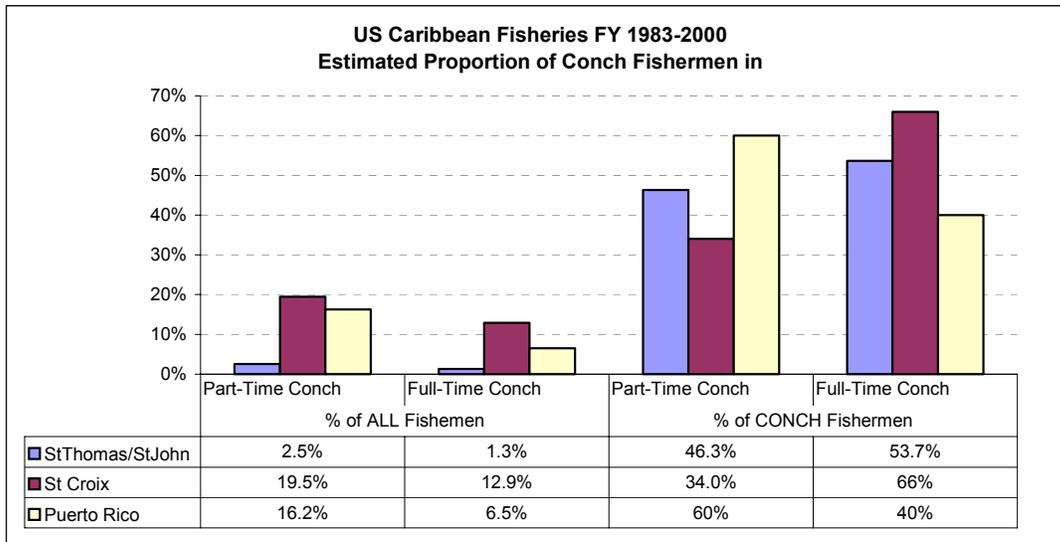


Figure 24. U.S. Caribbean. Proportion of “full-time” and “part-time” conch fishermen by island. All years were combined (St. Thomas/St. John: 1986-1999; St. Croix: 1987-1998; Puerto Rico: 1983-2000), and the proportions were drawn from the totals. Percentages of full-time and part-time conch fishermen are given with respect to the total number of fishermen and with respect to all the conch fishermen.

**PUERTO RICO
All Trips Reported**

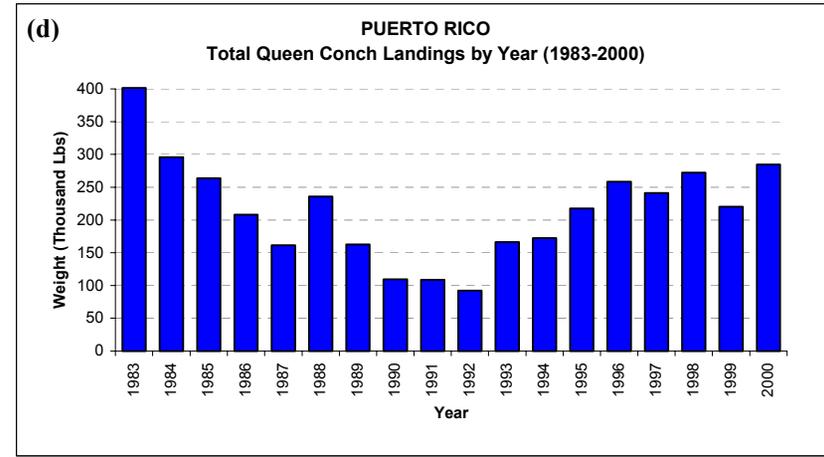
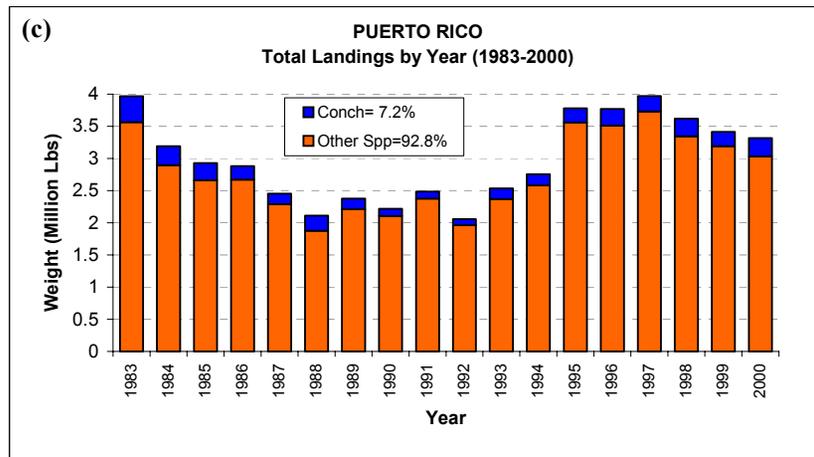
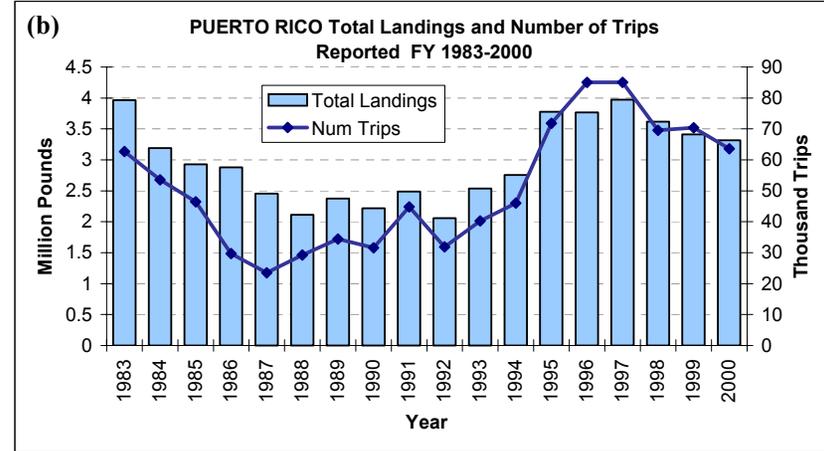
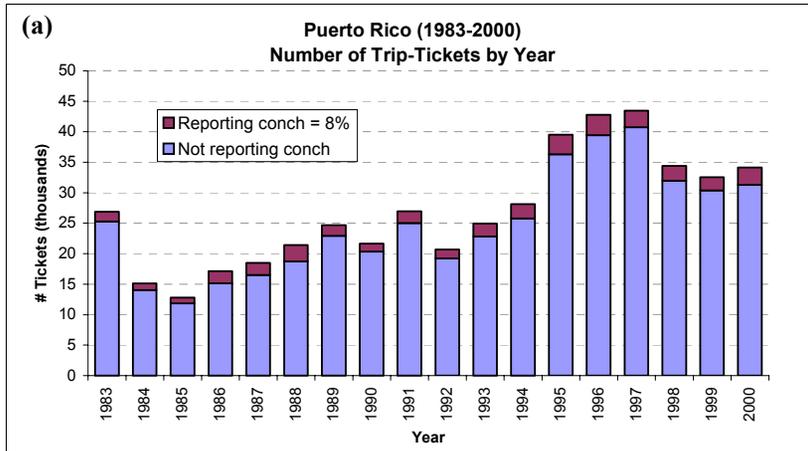


Figure 25. (a) Estimated number of trip-tickets collected in Puerto Rico (years 1983-2000). The number of tickets that reported and that did not report queen conch landings are provided. (b) Total combined multispecies landings and total number of trips reported by year. (c) Proportion of conch and other species' landings by year. (d) Total queen conch landings by year.

PUERTO RICO - All Trips Reported
(1983-2000)

Seasonal (Monthly) Trends in Catch and Effort Statistics

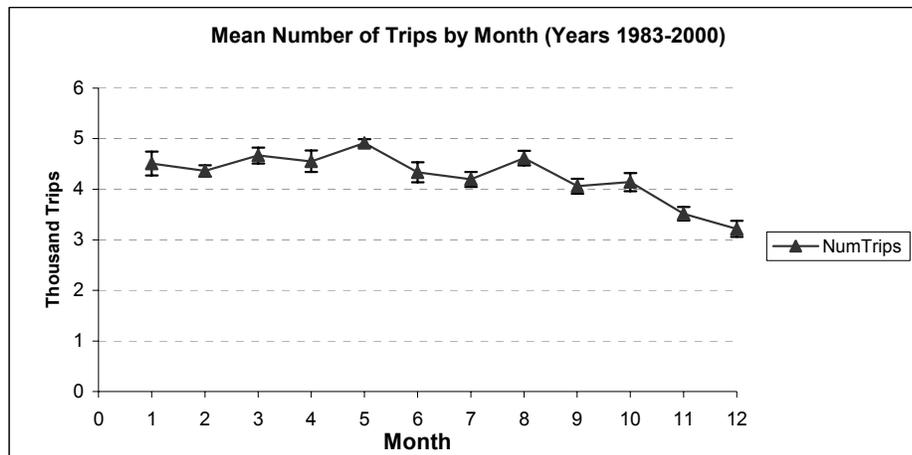
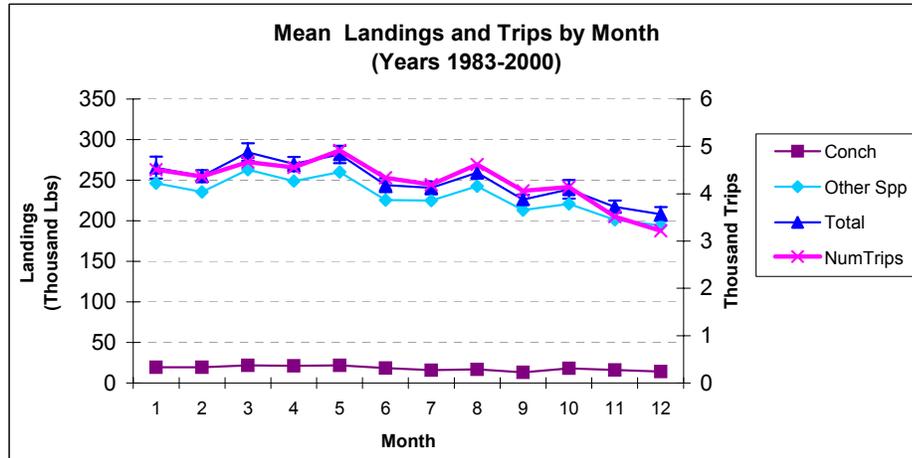


Figure 26. Puerto Rico. Estimated mean monthly landings and mean number of trips for years 1983-2000 combined. The bottom figure shows only the mean number of trips for clarity. Error bars are standard errors of the estimates.

**PUERTO RICO
Nominal Catch Rates**

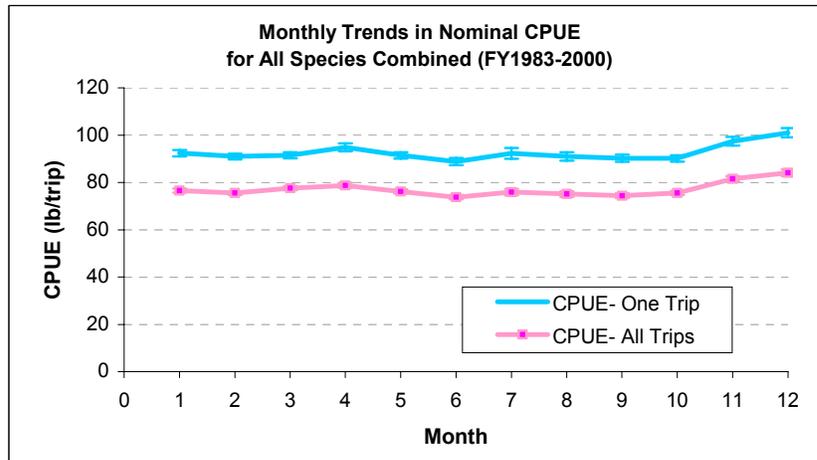
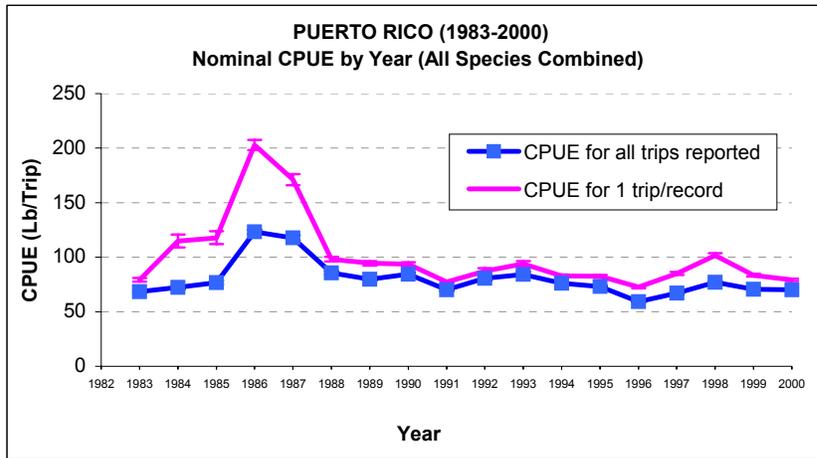


Figure 27. Puerto Rico. Estimated nominal catch rates by year and by month for all the species combined. CPUEs were estimated using all the trips reported and using only the records that reported single trips. Error bars are standard errors.

PUERTO RICO All Trips Reported

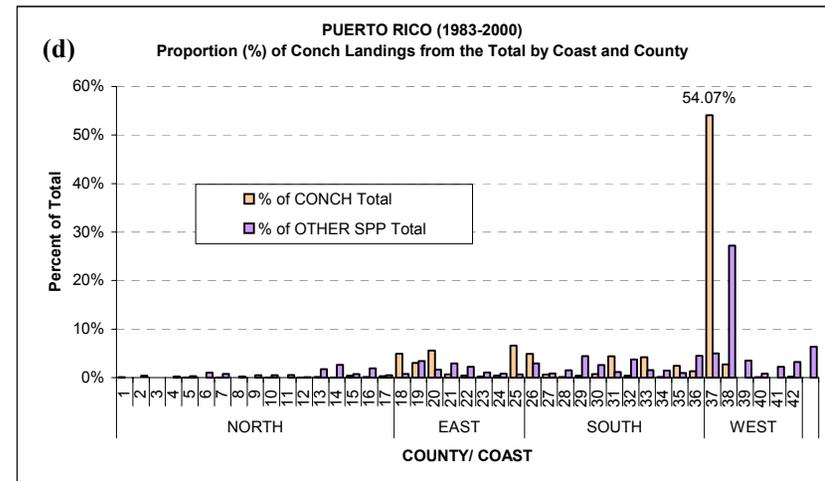
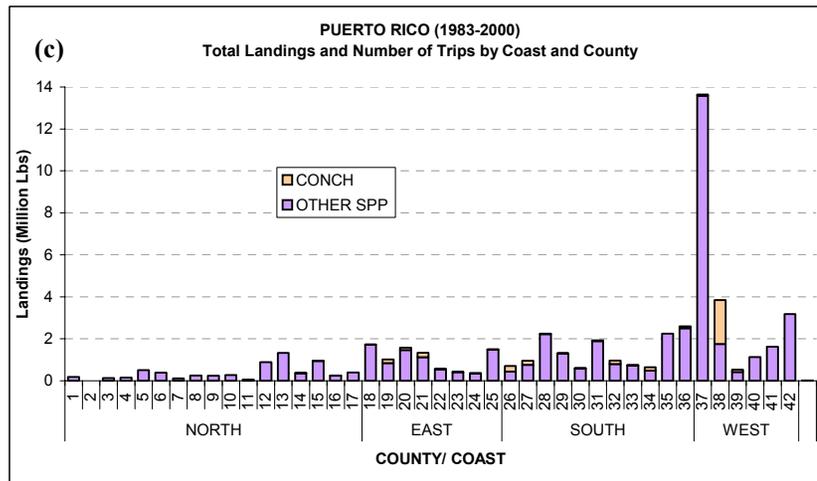
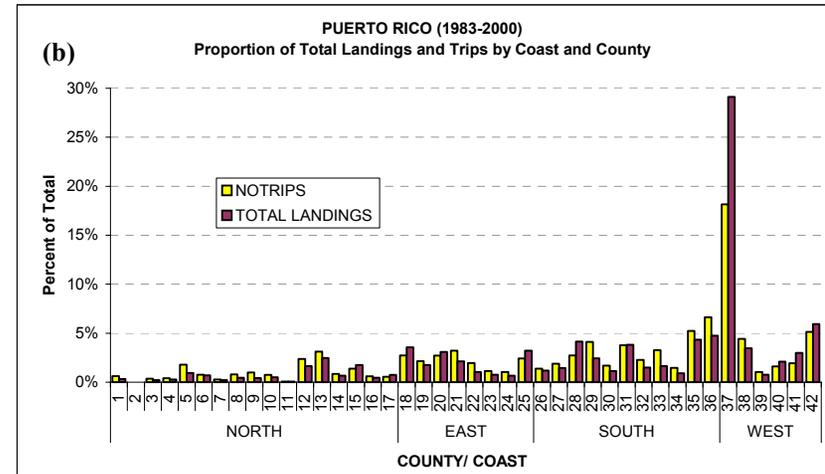
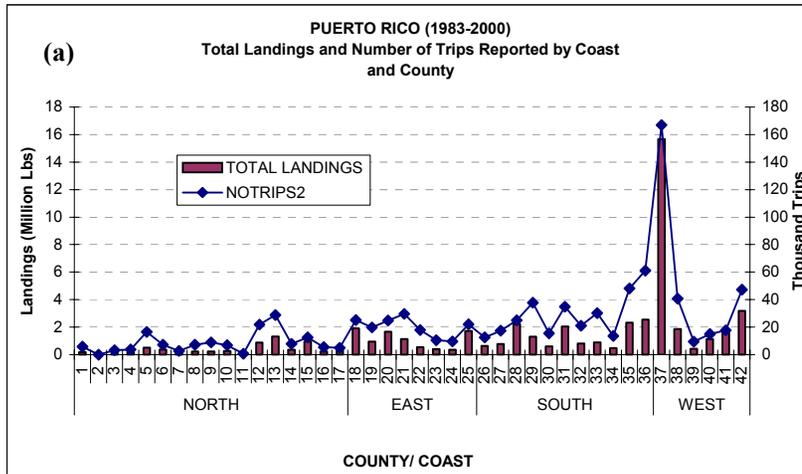


Figure 28. Puerto Rico. Landings and trips by coast and county (1983-2000). The figures on the left show the aggregated multispecies landings and the total number of trips; the figures on the right represent proportions (%) of the totals. Figures (b) and (d) show the total landings broken down into conch and other species.

PUERTO RICO
All Trips Reported

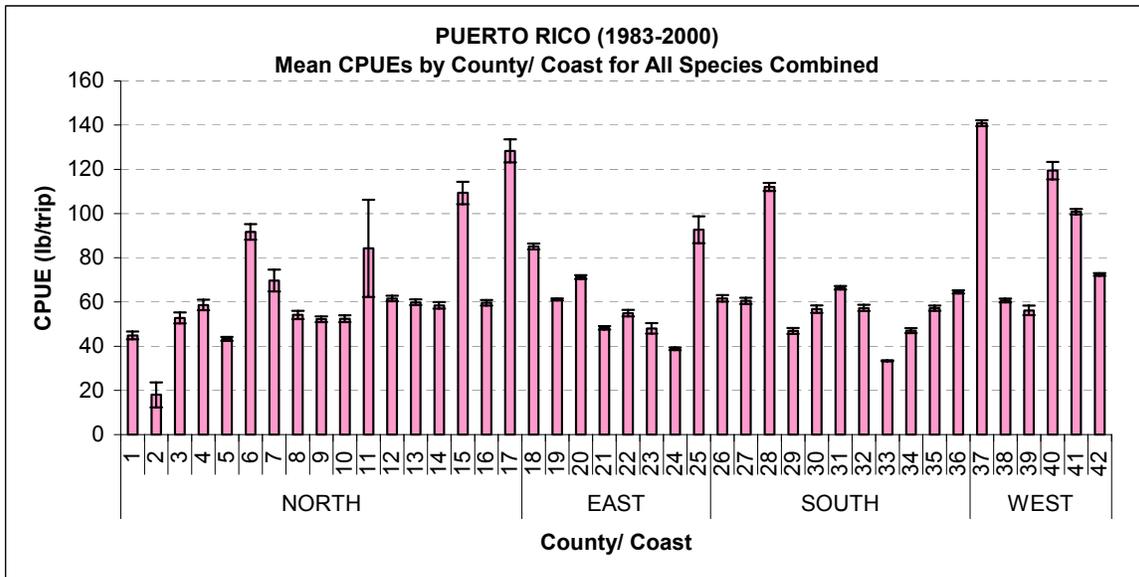
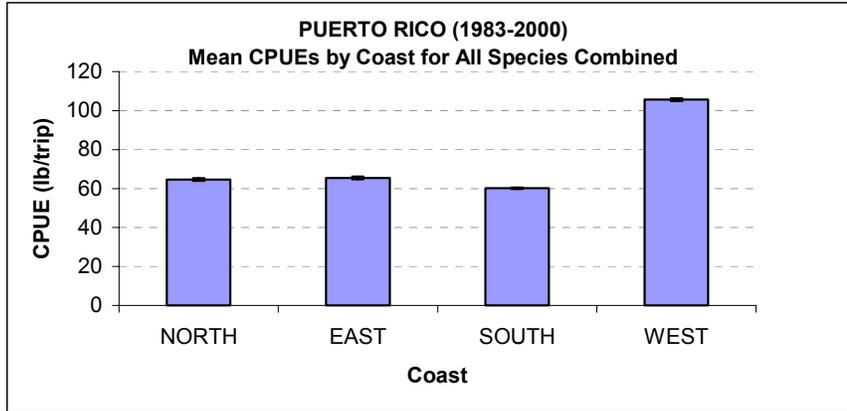


Figure 29. Puerto Rico. Mean nominal catch rates (in lb/trip) by coast and by municipality for all species and years (1983-2000) combined. Municipality (county) codes are provided in Appendix B.

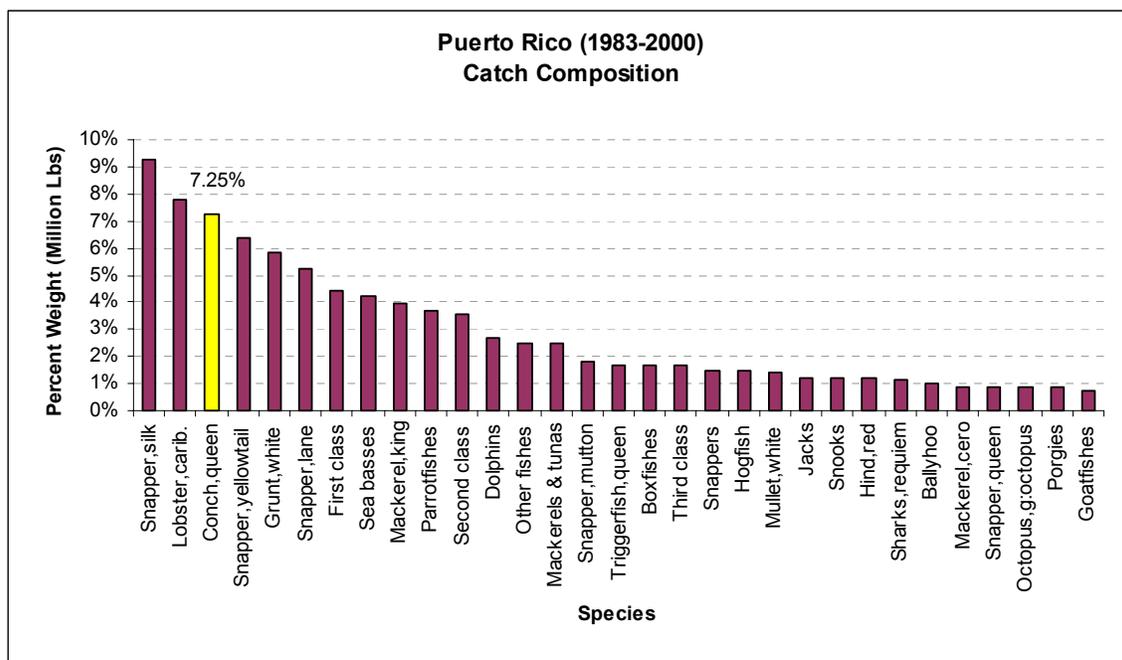


Figure 30. Puerto Rico. Catch composition of the aggregated multispecies fishery for years 1983-2000. The values are illustrated as fractions (%) of the total landings. Only the species/ species groups that represented > 0.7% of the total catch (and that added up to a cumulative 90%) are shown; the other species had a very small representation. A 7.25 % of the total corresponded to queen conch landings.

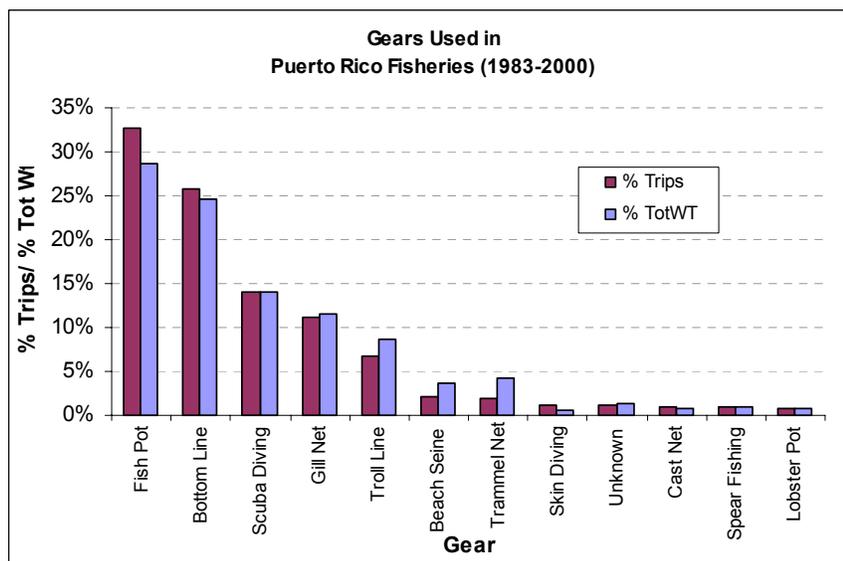
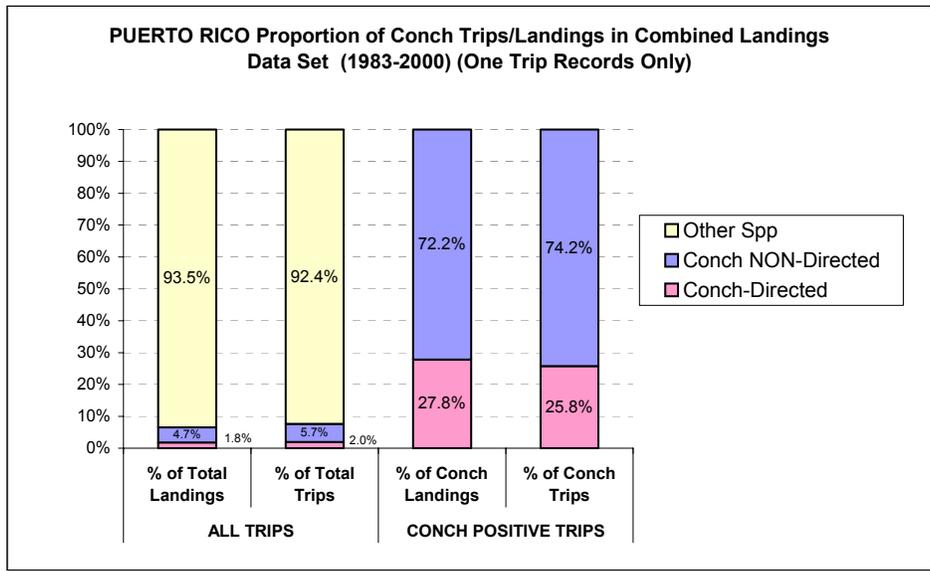


Figure 31. Puerto Rico. Gears most frequently used in the multispecies fishery (1983-2000). The proportions (%) of the total number of trips and of the total weight harvested with each gear are shown.



Trip Classification	ALL TRIPS		CONCH POSITIVE TRIPS	
	% Total Landings	% Total Trips	% Conch Landings	% Conch Trips
Conch Positive	6.51%	7.63%	72.18%	74.22%
Conch Only	1.81%	1.97%	27.82%	25.78%
Other Spp	93.49%	98.03%		

Figure 32. Puerto Rico. Proportion (%) of queen conch fishing trips and of conch landings from the combined landings statistics database (1983-2000). Only single-trip records were used. Conch-positive= trips where at least 0.5 lb of conch was harvested; Conch-only= trips that targeted conch exclusively; Other Spp.= trips where only other species (and no conch) were harvested.

PUERTO RICO
Queen Conch Catch-Effort Time-Series
(Single-Trip Records)

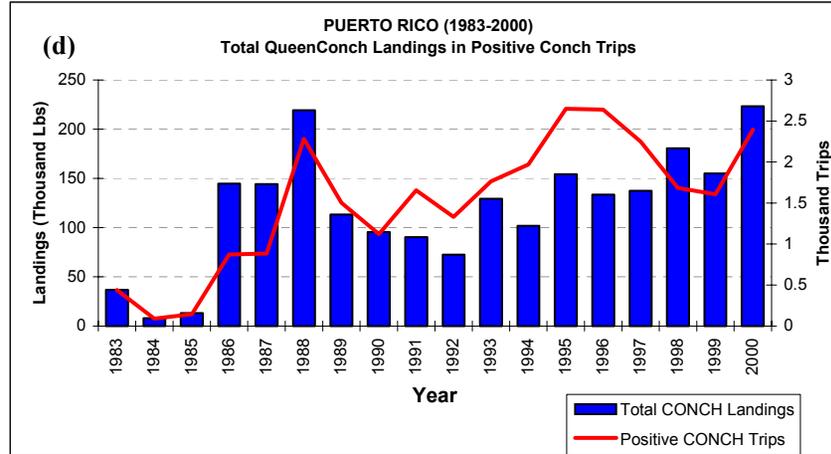
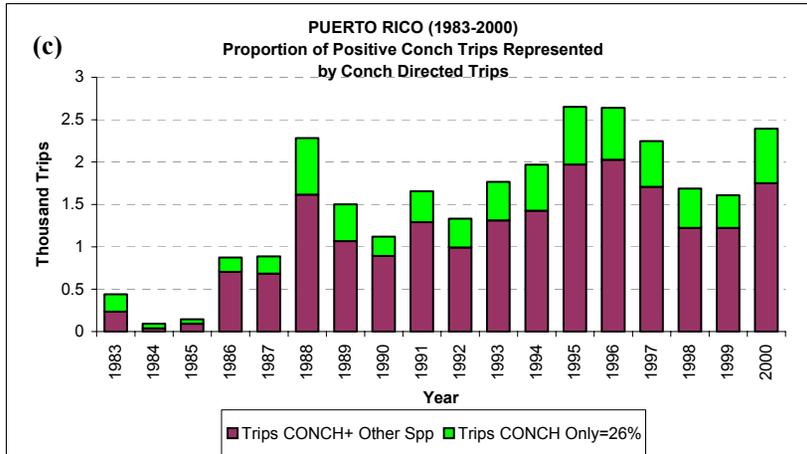
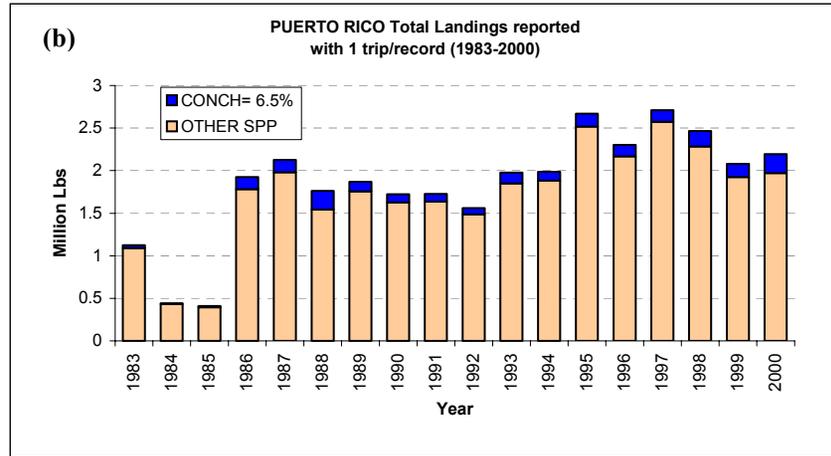
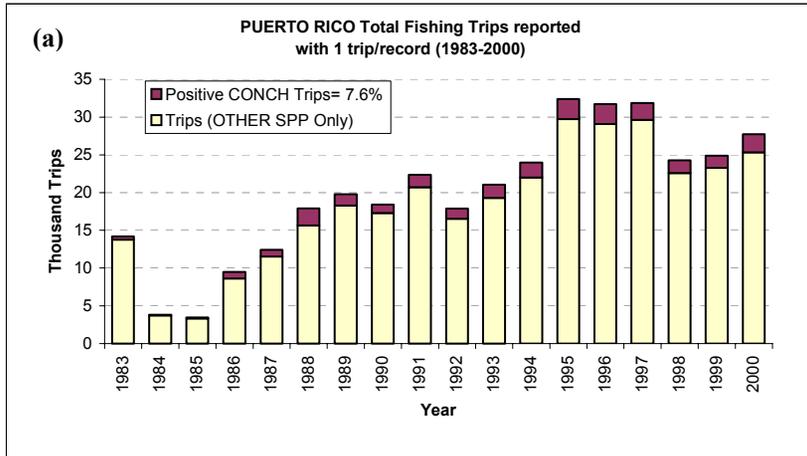


Figure 33. Puerto Rico **(a), (b)** Total queen conch landings and number of trips shown as proportions of the totals reported in single-trip records (1983-2000). **(c)** Proportion of positive conch trips represented by the directed sector (= trips conch only). **(d)** Total conch landings and positive conch trips.

PUERTO RICO
Queen Conch Catch-Effort Time-Series
(Single-Trip Records)

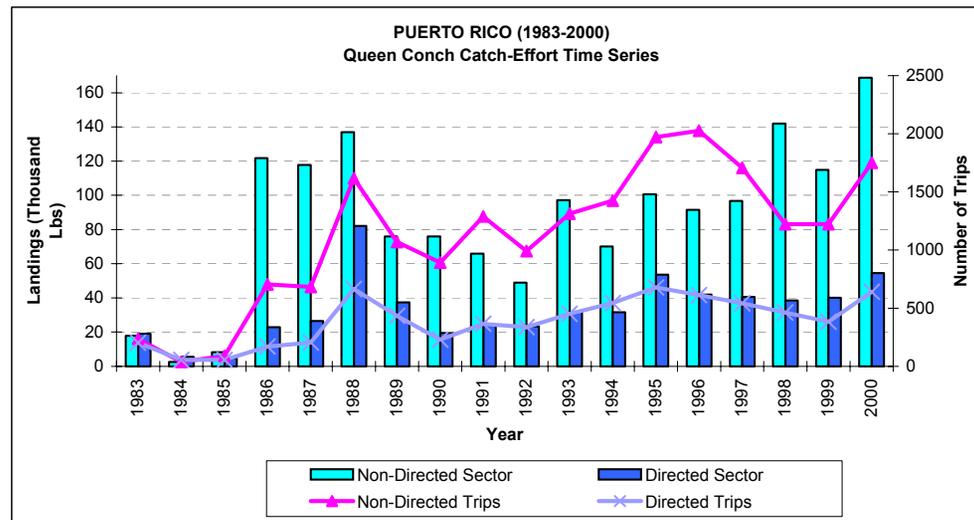
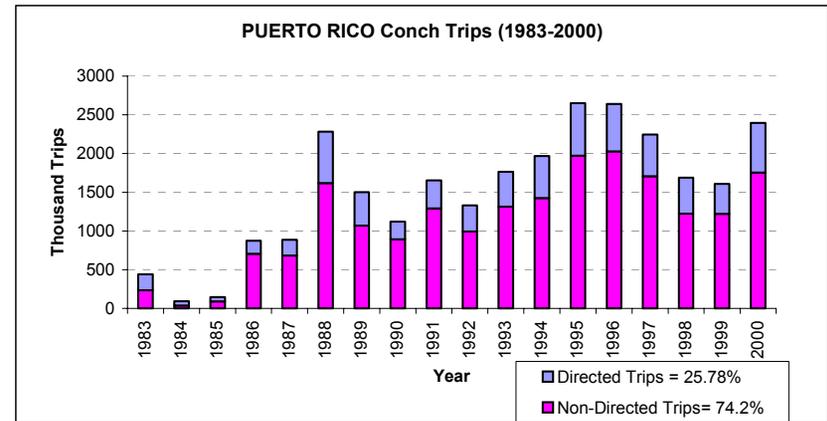
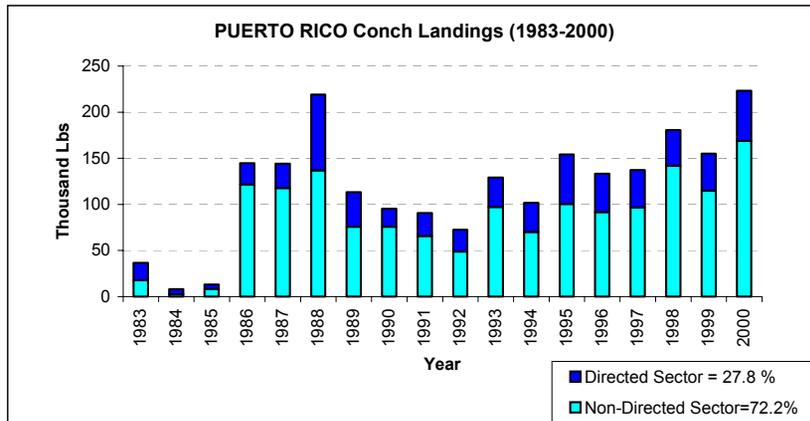


Figure 34. Puerto Rico (1983-2000). Proportions of the total landings and of the positive conch trips represented by the directed (conch-only) and non-directed (that harvest conch and other species) sectors of the queen conch fishery. Only single-trip records were used.

PUERTO RICO
Monthly Trends in the Catch and Effort Statistics

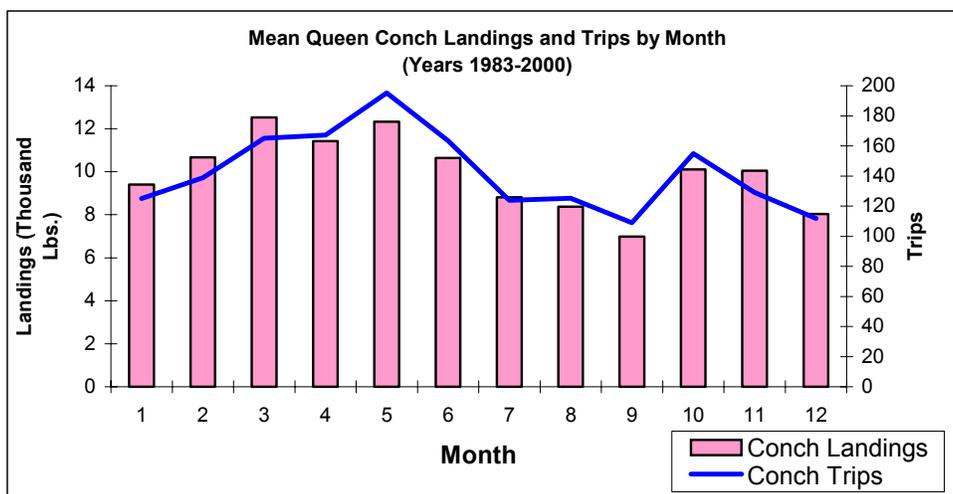
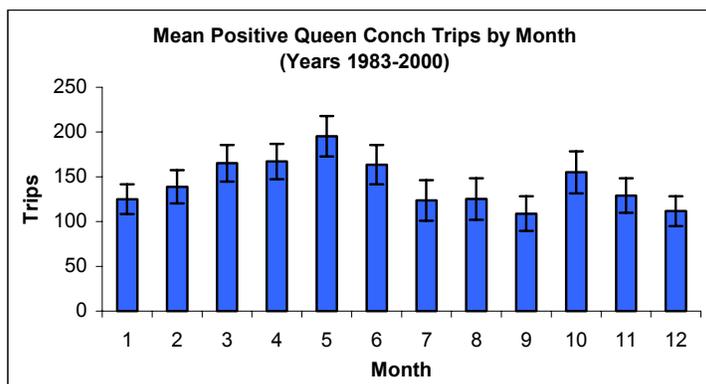
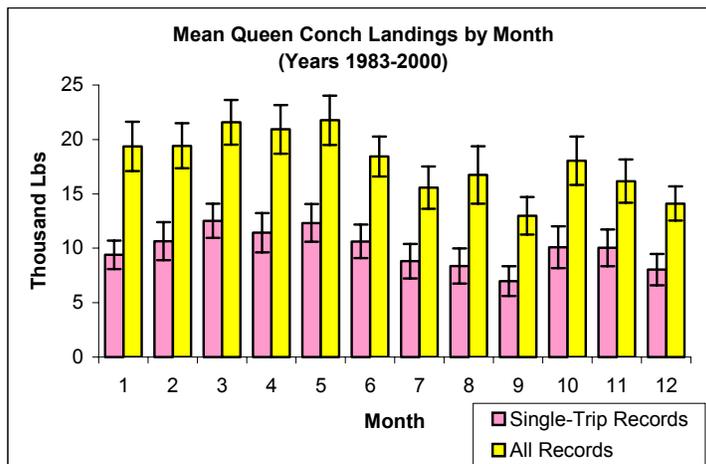


Figure 35. Puerto Rico. Estimated mean queen conch landings and number of positive conch trips by month for years 1983-2000. The top figure shows the monthly catch estimates obtained using all the records (including multiple-trip records) and the single-trip records. The last two figures illustrate only estimates obtained with single-trip records. Error bars are standard errors.

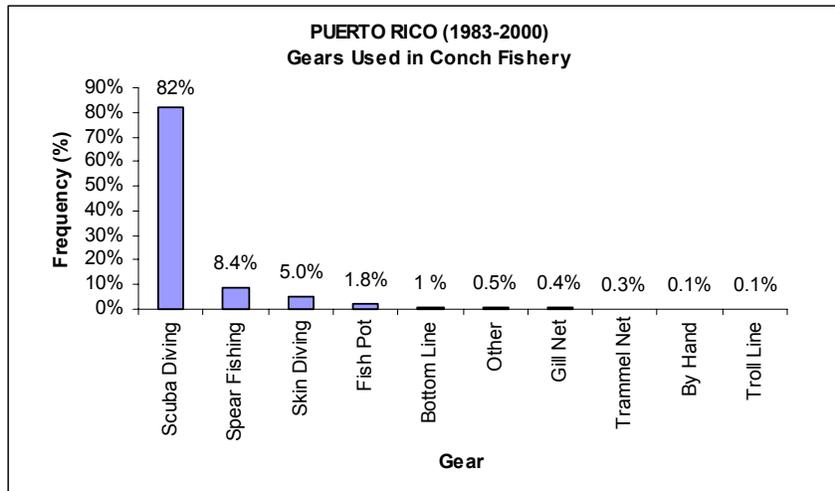


Figure 36. Puerto Rico (1983-2000). Gears most frequently used in the queen conch fishery. The frequency (%) of use of each gear is shown.

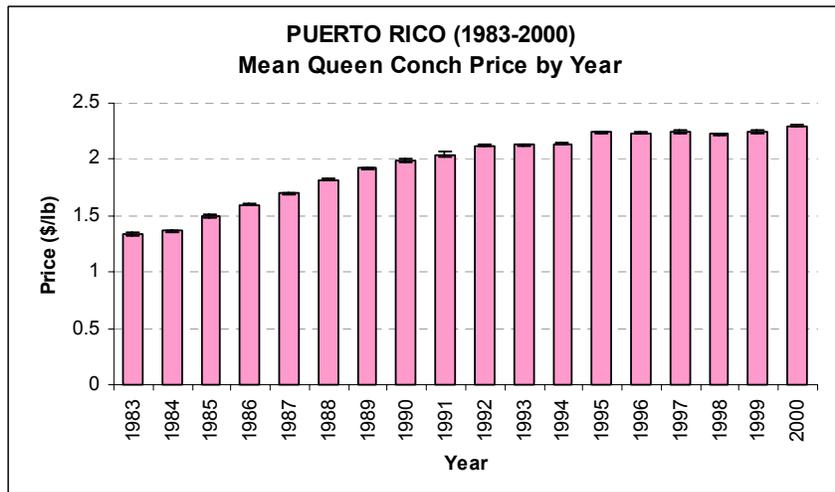


Figure 37. Puerto Rico (1983-2000). Mean queen conch price by year. Error bars are standard errors.

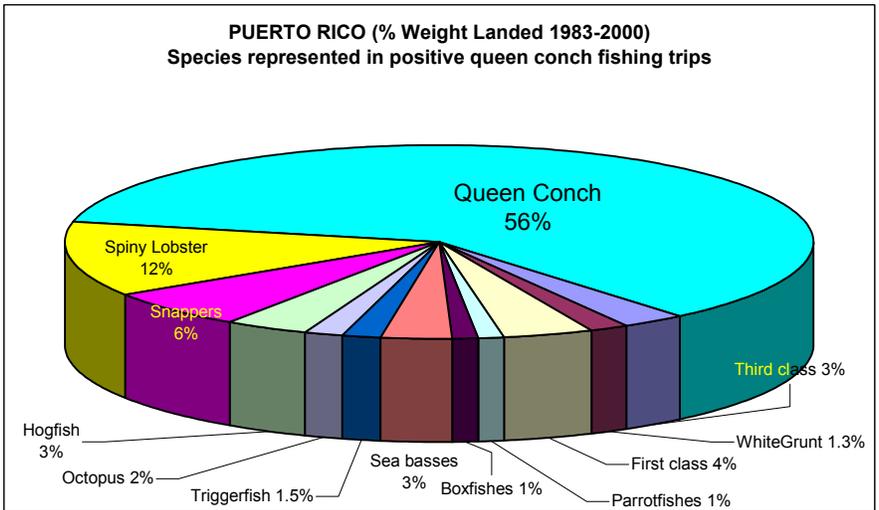
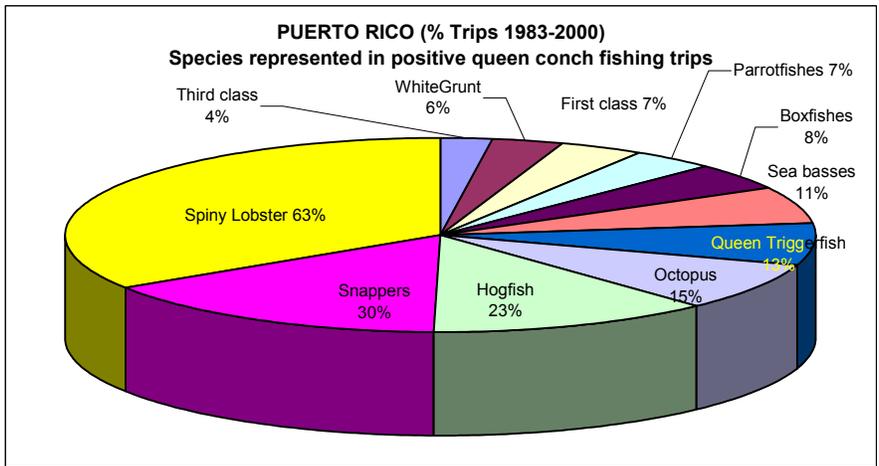
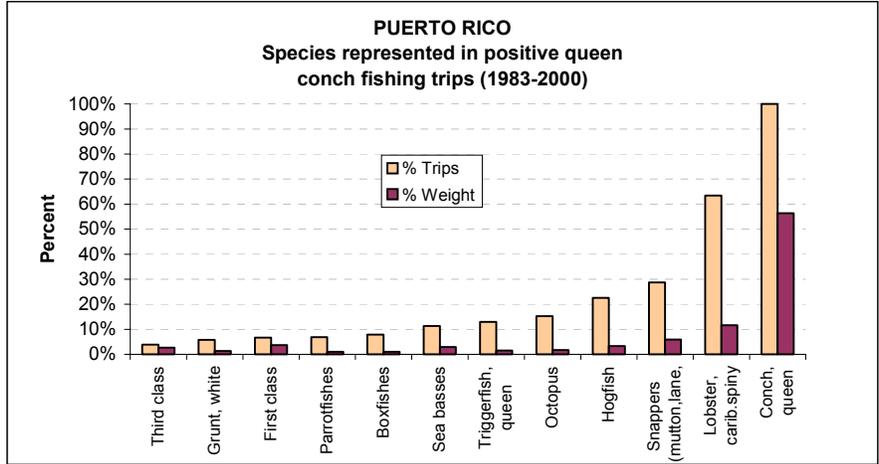


Figure 38. Puerto Rico (1983-2000). Species associated to the queen conch fishery. The representation of each species in positive queen conch trips is shown as the proportion (%) of trips present (species with >4% presence) and as a proportion of the total weight landed (species with >1% of total weight). The data was combined for all years. The pie charts are provided as alternative, more detailed illustrations of the bar chart on top.

PUERTO RICO
Single-Trip Records

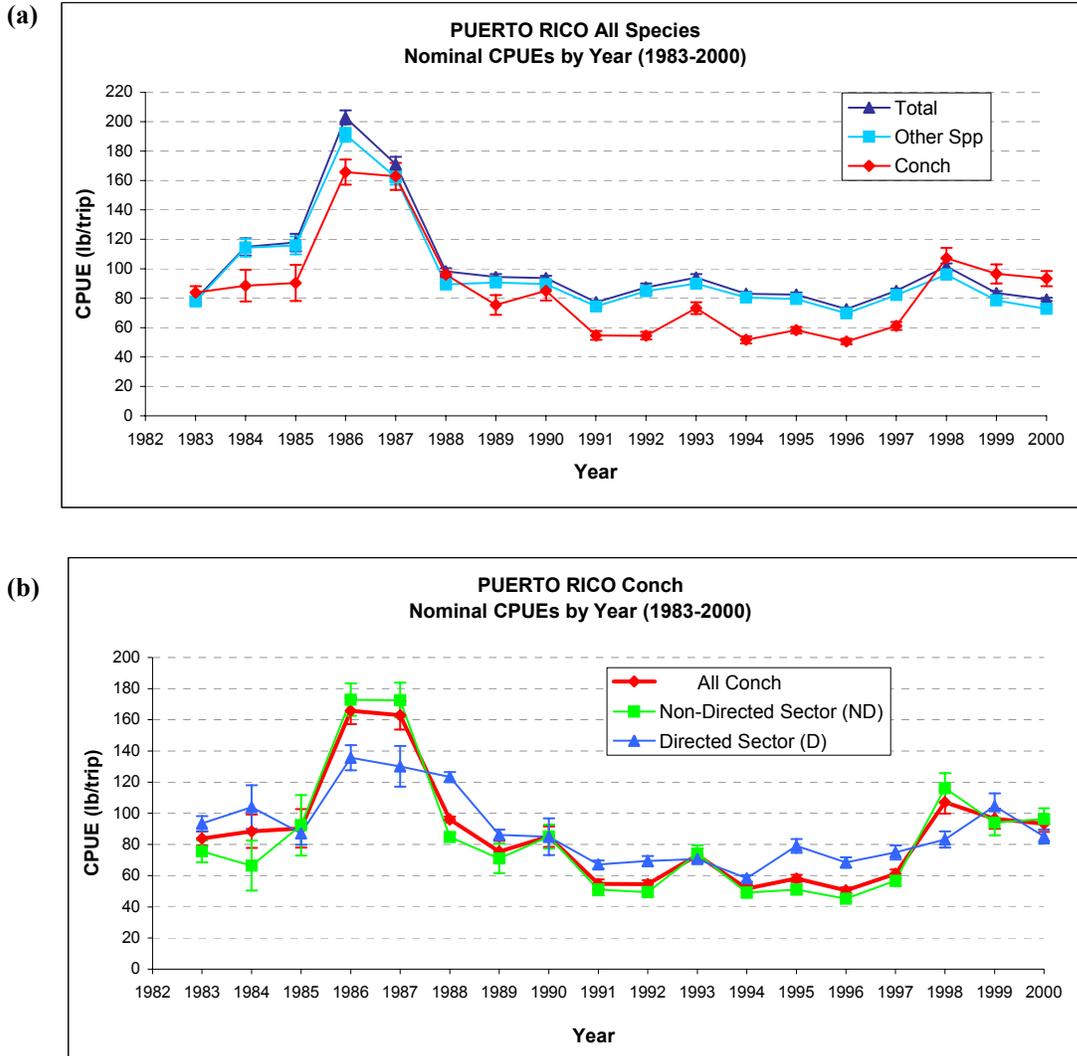


Figure 39. Puerto Rico (1983-2000). Estimated nominal catch rates by year for: (a) all species combined (= Total), queen conch, and all other species; (b) the two sectors of the queen conch fishery (Directed/ Non-Directed) and for the whole fishery (All Conch). All CPUEs were estimated using single-trip records. Units are pounds per trip (lb/trip). Error bars are standard errors.

(c)

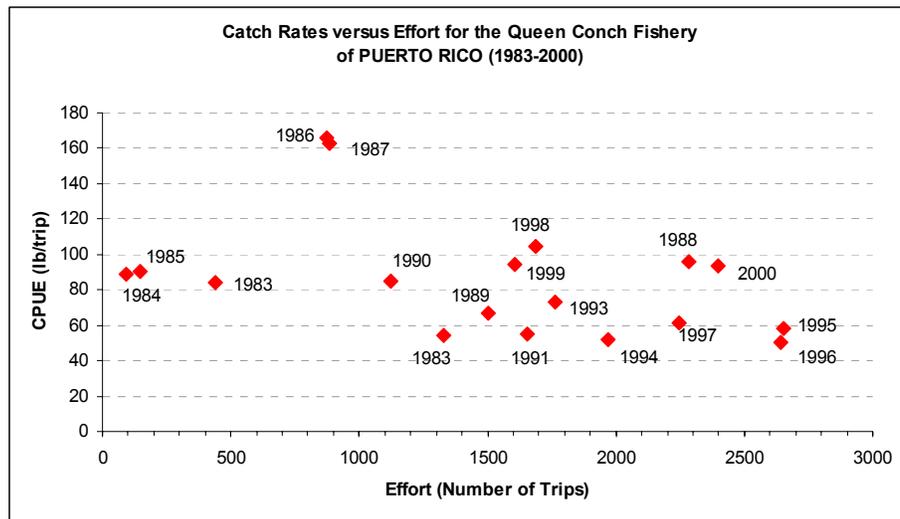


Figure 39. (Cont.) (c) Catch rates (lb/trip) versus effort (number of trips) for the whole queen conch fishery of Puerto Rico using single-trip records.

PUERTO RICO
One Trip Records Only

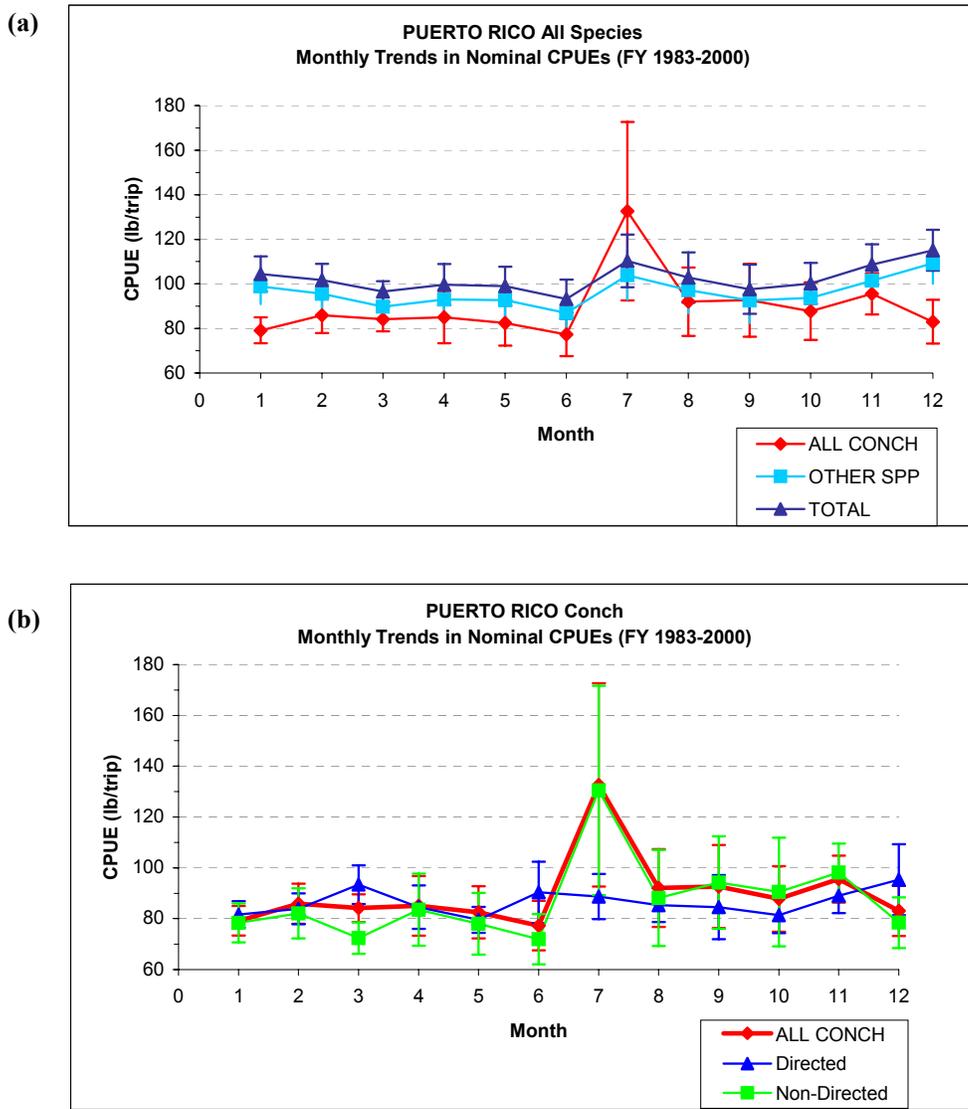


Figure 40. Puerto Rico (1983-2000). **(a)** Estimated nominal catch rates by month for all the species combined (Total), for queen conch and for all other species. **(b)** Estimated nominal catch rates for the two sectors of the queen conch fishery (directed/ non-directed) and for the whole fishery (all conch trips) by month. All CPUEs were estimated using single-trip records. Error bars are standard errors.

PUERTO RICO (1983-2000)
Catch Rate Distribution by Coast and County

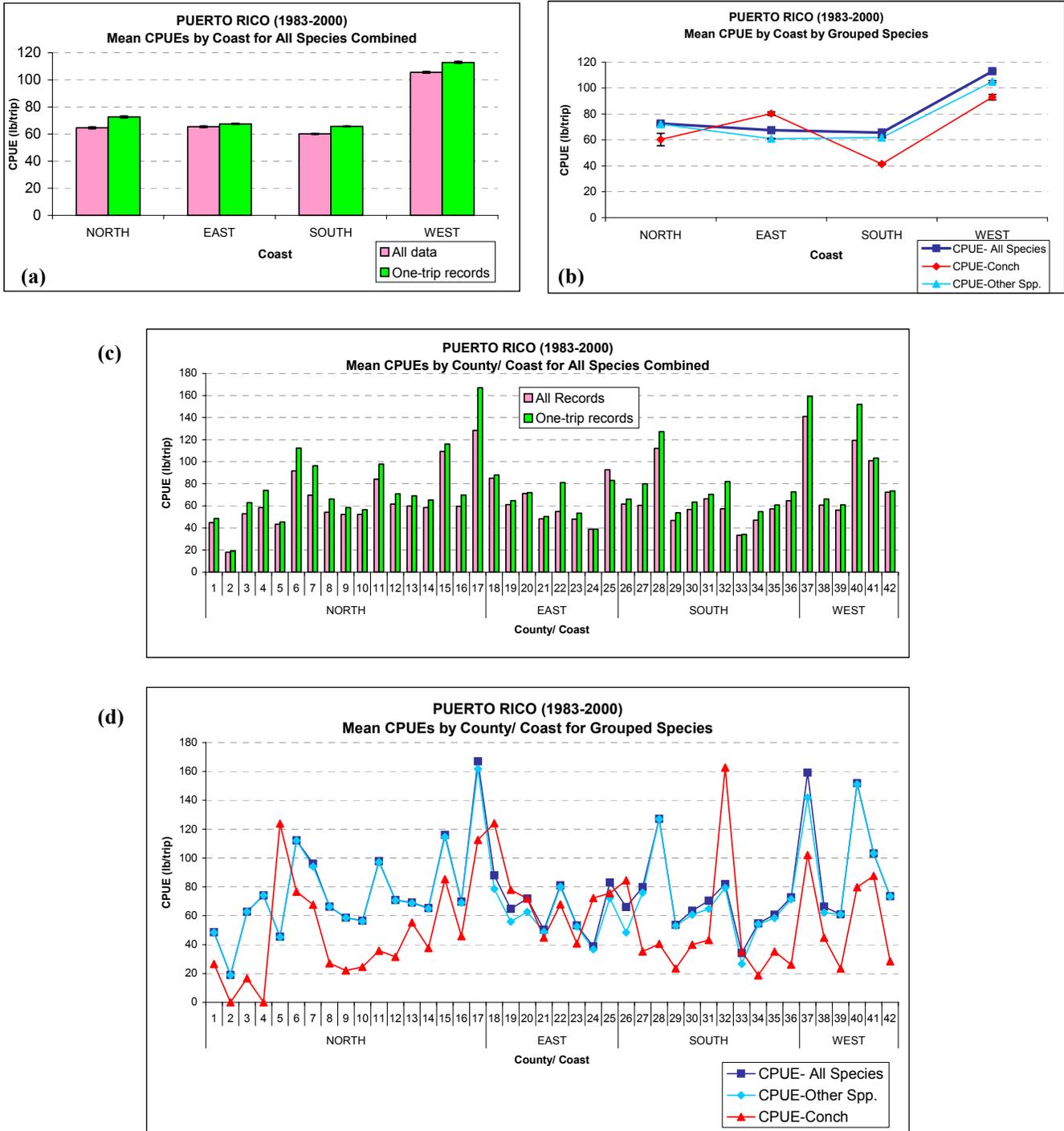


Figure 41. Puerto Rico (1983-2000). Nominal catch rate distribution by coast and municipality (county) for years 1983-2000 combined. Mean nominal catch rates are shown for: **(a)** All species combined by coast; **(b)** Grouped species (all, conch, other) by coast; **(c)** All species combined by county/coast (estimates obtained with all records and with single-trip records are shown; see **Fig. 29**); **(d)** Grouped species by county/coast. All CPUEs were estimated using single-trip records. Error bars are standard errors. Municipality codes are provided in Appendix B.

PUERTO RICO (1983-2000)
Catch Rate Distribution for QUEEN CONCH by Coast and County

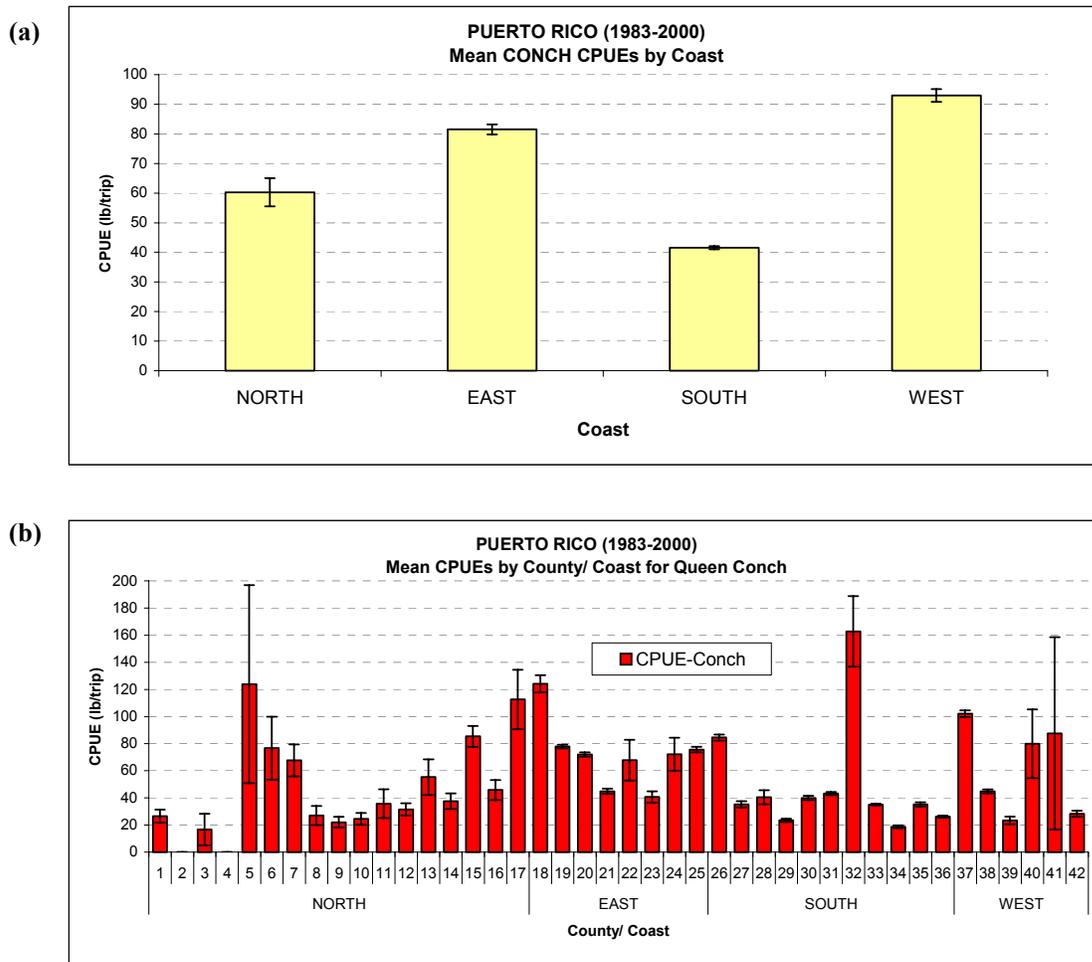


Figure 42. Puerto Rico. Queen conch nominal catch rates by coast and municipality (county) for years 1983-2000 combined. (a) Mean queen conch catch rates by coast; (b) Mean queen conch catch rates by county/coast. All CPUEs were estimated using single-trip records. Error bars are standard errors. Municipality codes are provided in Appendix B.

PUERTO RICO (1983-2000)
Estimation of "Full-Time" Conch Fishermen from the Landings Statistics Database

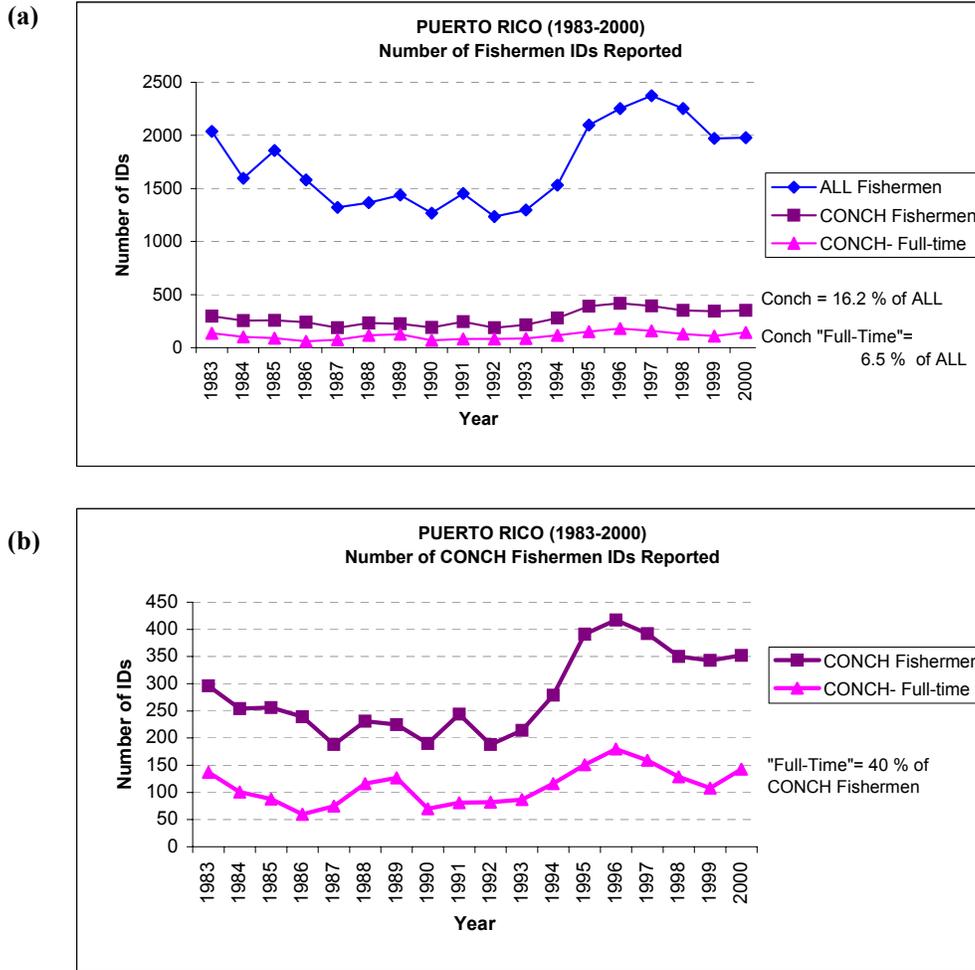


Figure 43. Puerto Rico. Number of fishermen estimated from the identification numbers reported in the landings statistics database (1983-2000). **(a)** Proportion of conch fishermen and “full-time” conch fishermen with respect to the total number of fishermen estimated; **(b)** Proportion of “full-time” conch fishermen from all the conch fishermen estimated. The mean proportions by island for the U.S. Caribbean are shown in **Figure 24**.

APPENDIX A
U.S. VIRGIN ISLANDS

Area	Code	Location Codes found in USVI data files
British Virgin Islands	BBB	BBB
St. Thomas/St. John	STJ or T	JN, JS, JSE, JSW, T2, TAA, TNE, TN, THS, TNW, TSE, TSW, TTT, TW, TWN, TWT, TSW, 0
St. Croix	X	XN, XNE, XNW, XS, XSE, XSW, XXX, C1, C2, C3, C4, C5, 1
Unknown	ZZZ, ? or blank	

Table A.1. Summary of all location codes with corresponding area codes found in the USVI Landings database (1986-1999) (taken from Bolden 2001).

Code	Gear Type
D	Diving
H	Hook & Line
N	Net
P	Pot or trap
G	Gill net
N	Siene net
F	Free diving
S	Scuba
T	Trap
L	Line fishing
C, L	Both castnet and line fishing
F,L or L,F	Free diving and line fishing

Table A.2. Summary of all gear codes codes with corresponding gear type found in the USVI Landings database (1986-1999) (taken from Bolden 2001).

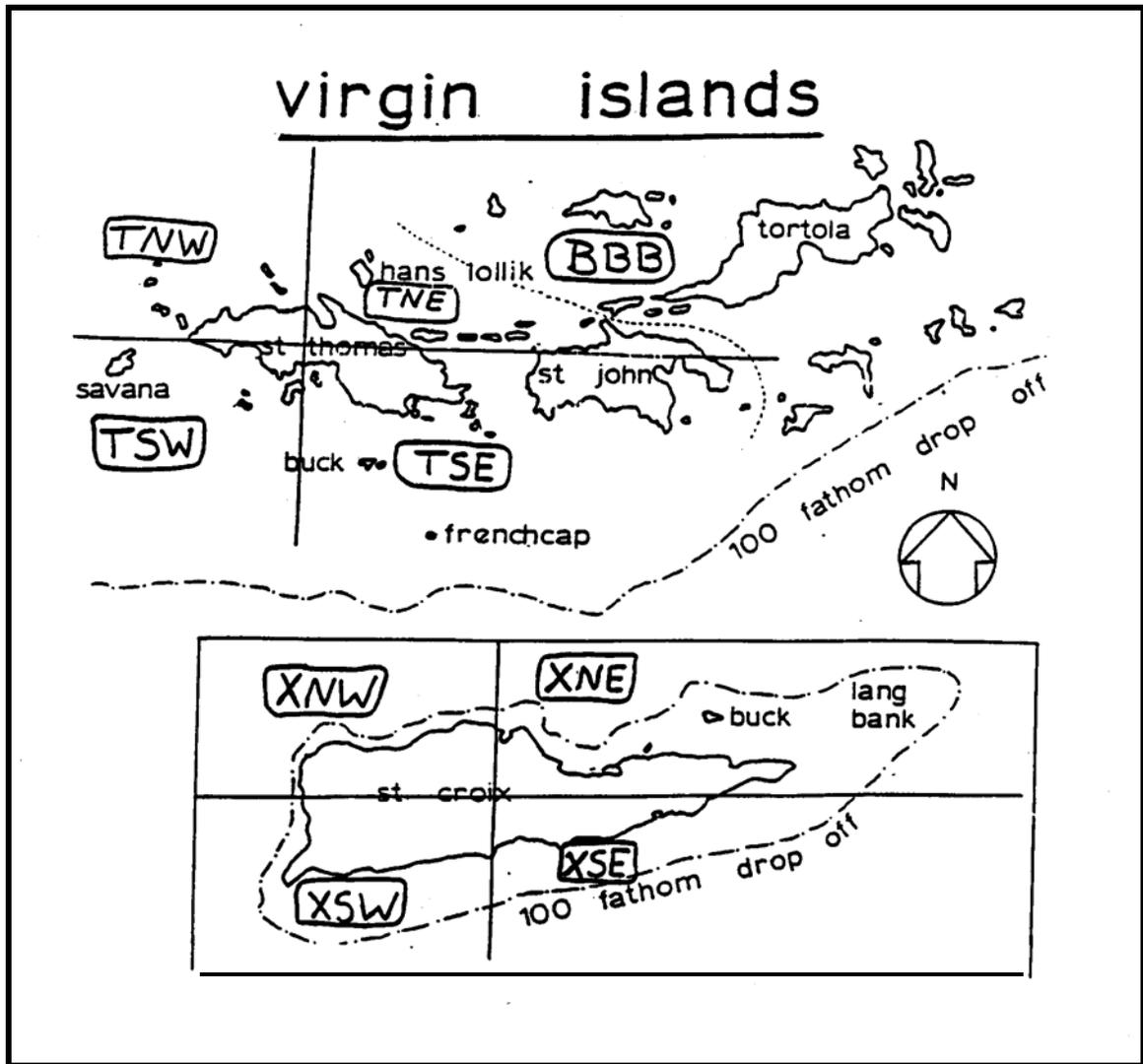


Figure A.1. Chart of the U. S. Virgin Islands fishing areas provided in the standard (old) catch report forms.

Catch Report Forms, revised
 for Commercial Fisheries of the U.S. Virgin Islands
 July 1999 - June 2000

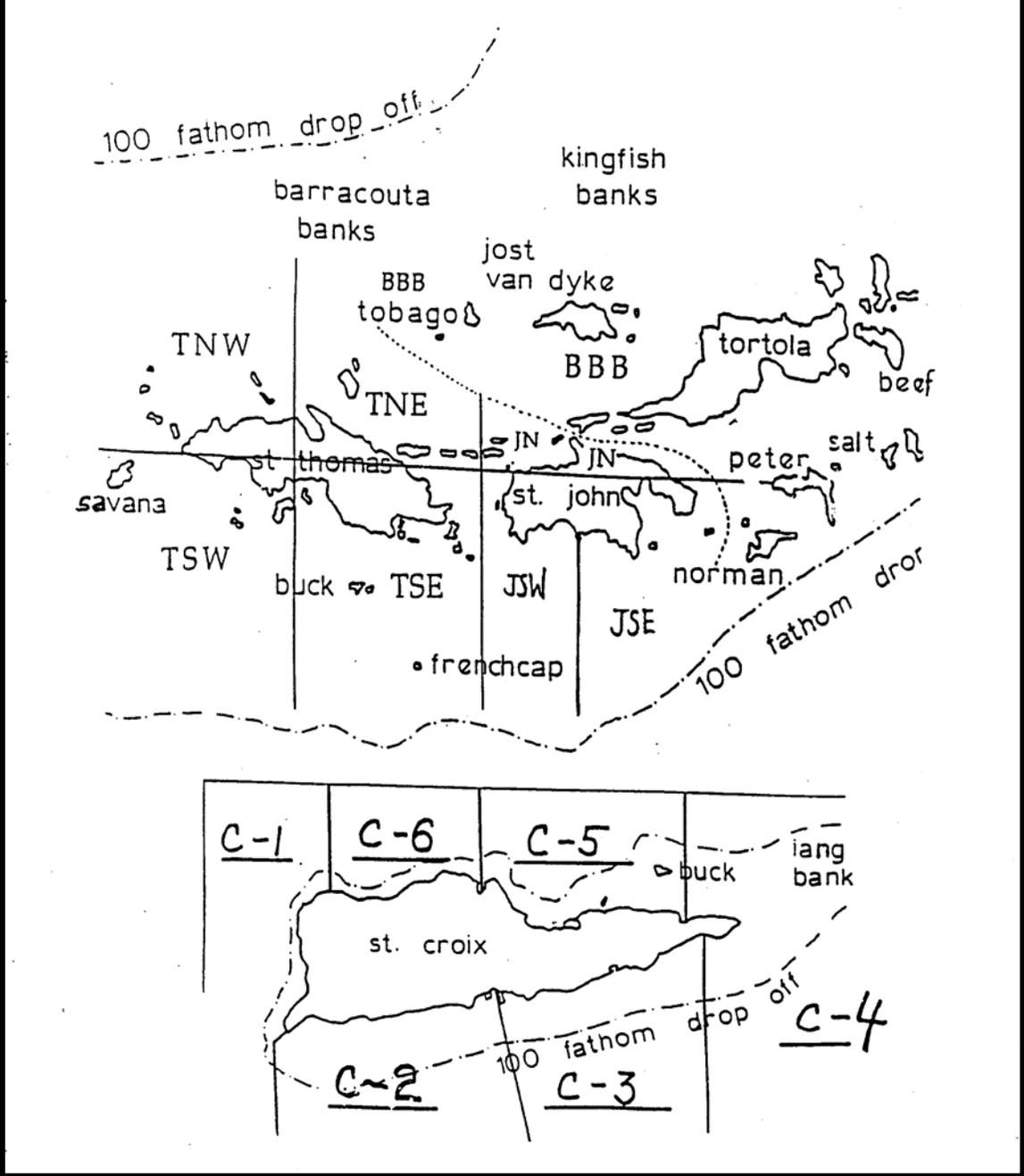


Figure A.2. Chart of the U. S. Virgin Islands fishing areas provided in the revised (new) catch report forms.

FILL OUT THIS STUB
WHEN YOU SEND IN
YOUR CATCH REPORT.

COMMERCIAL CATCH REPORT FORM FOR **JUNE 1996**

ID number _____
 name _____ boat reg. no. _____ number of helpers used _____
 home port _____ buoy colors _____ Did you fish this month? Yes ___ No ___

Tear at the perforated line. Keep this stub and send in the catch report.

The catch report for
JUNE 1996
was

mailed to Fish & Wildlife

date _____

dropped off at Fish & Wildlife

date _____

received by:

You can bring this stub to Fish & Wildlife and get a signature when you drop off the form.

Mail to:
 Division of Fish & Wildlife
 6291 Estate Nazareth 101
 St. Thomas, VI 00802-1104
 775-6762
 or
 Division of Fish & Wildlife
 Lagoon St. Complex, Room 203
 Fredericksted, St. Croix VI 00840
 772-1955

Division of Fish & Wildlife 95.0612 CWB

day of month	POT FISH		HOOK FISH	NET FISH	SPEARGUN FISH	POT LOBSTER		LOBSTER	CONCH	BAITFISH/FRY	AREAS FISHED ↓	Did you fish more than 3 miles from shore (Yes/No/Both)
	lbs	# Pots Hauled	lbs	lbs	lbs	lbs	# Pots Hauled	by DIVING	lbs of meat	lbs		
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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22												
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26												
27												
28												
29												
30												
31												

Division of Fish & Wildlife 95.0612 CWB

I attest that the information recorded on this form is true and accurate.

(sign & date)

Figure A.3. U.S. Virgin Islands standard (old) commercial catch report form. This was the only form used in St. Thomas-St. John until fishing year FY 1995-1996 and in St. Croix until FY 1993-1994. It was still used by the majority of fishermen in St. Croix until FY 1995-1996

initials _____

REVISED COMMERCIAL CATCH REPORT FORM FOR **APRIL 1999**

name _____ boat reg. no. VI- _____ buoy colors _____ total traps in water: fish pots _____ lobster pots _____ no. helpers used _____

Day	Gear Type	Gear No.	Area Fished	Hours Fished	Grouper lbs	Snapper lbs	Grunts lbs	Jack lbs	Surgeon lbs	Parrot lbs	Shellfish lbs	Trigger lbs	Angel lbs	Barra lbs	Goat lbs	Mackrl lbs	offshore D/T/W lbs	FAD	Baitfish lbs	Lobster lbs	Conch meat	Whelk-meat	Distance from land	
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
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28																								
29																								
30																								

Received at DFW

Division of Fish & Wildlife 98.06 CWB

I attest that the information recorded on this form is true and accurate.

(sign & date)

Figure A.4. U.S. Virgin Islands revised (new) commercial catch report form, introduced in St. Croix in FY 1994-1995 and in the entire U.S. Virgin Islands in FY 1996-1997.

Use these Codes on your catch reports:

Gear Type

Traps = T.....
 Gillnet = G.....
 Castnet = C.....
 Seine Net = N.....
 SCUBA = S.....
 Line Fishing = L.....
 Free Diving (without Scuba) = F.....

Gear Number

total number of traps hauled
 total number of nets used
 total number of nets used
 total number of nets used
 total number of Scuba divers
 total number of lines fished
 total number of free divers

Hours Fished = total hours spent fishing

TYPE OF FISH CAUGHT

Write the total pounds of each fish type caught for each day

Grouper 	Snapper 	Grunt 	Jack 
Surgeonfish 	Parrotfish 	Shellfish 	Triggerfish 
Angelfish 	Barracuda 	Goatfish 	Mackerel 
Offshore D = Dolphin 	FAD - Fish Attracting Device B = Buck Island C = Cane Bay E = East Point	Baitfish 	Fry
T = Tuna 	N = Navy Buoy U = Underwater Navy Buoy		Sprat
W = Wahoo 			Ballyhoo
Lobster 	Conch 		Flying Fish
	Whelk 	For fish that are not listed, fill in the fish name and total pounds	

Distance from shore - estimate the distance from shore (in miles) where you fished most for each day
 - write the distance to the nearest 1/2 mile. If less than 1/2 mile from shore, then write "0".

Figure A.5. U.S. Virgin Islands. Revised catch report form diagram.

APPENDIX B

PUERTO RICO

CODE	Municipality
NORTH	
1	ISABELA
2	QUEBRADILLAS
3	CAMUY
4	HATILLO
5	ARECIBO
6	BARCELONETA
7	MANATI
8	VEGA BAJA
9	VEGA ALTA
10	DORADO
11	TOA BAJA
12	CATAÑO
13	SAN JUAN
14	CAROLINA
15	LOIZA
16	RIO GRANDE
17	LUQUILLO
EAST	
18	FAJARDO
19	CEIBA
20	NAGUABO
21	HUMACAO
22	YABUCOA
23	MAUNABO
24	CULEBRA
25	VIEQUES
SOUTH	
26	PATILLAS
27	ARROYO
28	GUAYAMA
29	SALINAS
30	SANTA ISABEL
31	JUANA DIAZ
32	PONCE
33	PEÑUELAS
34	GUAYNILLA
35	GUANICA
36	LAJAS
WEST	
37	CABO ROJO
38	MAYAGUEZ
39	AÑASCO
40	RINCON
41	AGUADA
42	AGUADILLA

Table B.1. Coastal municipalities in Puerto Rico and codes assigned by the FRL/DNR.

CODIFICACION DE PUEBLOS Y BARRIOS

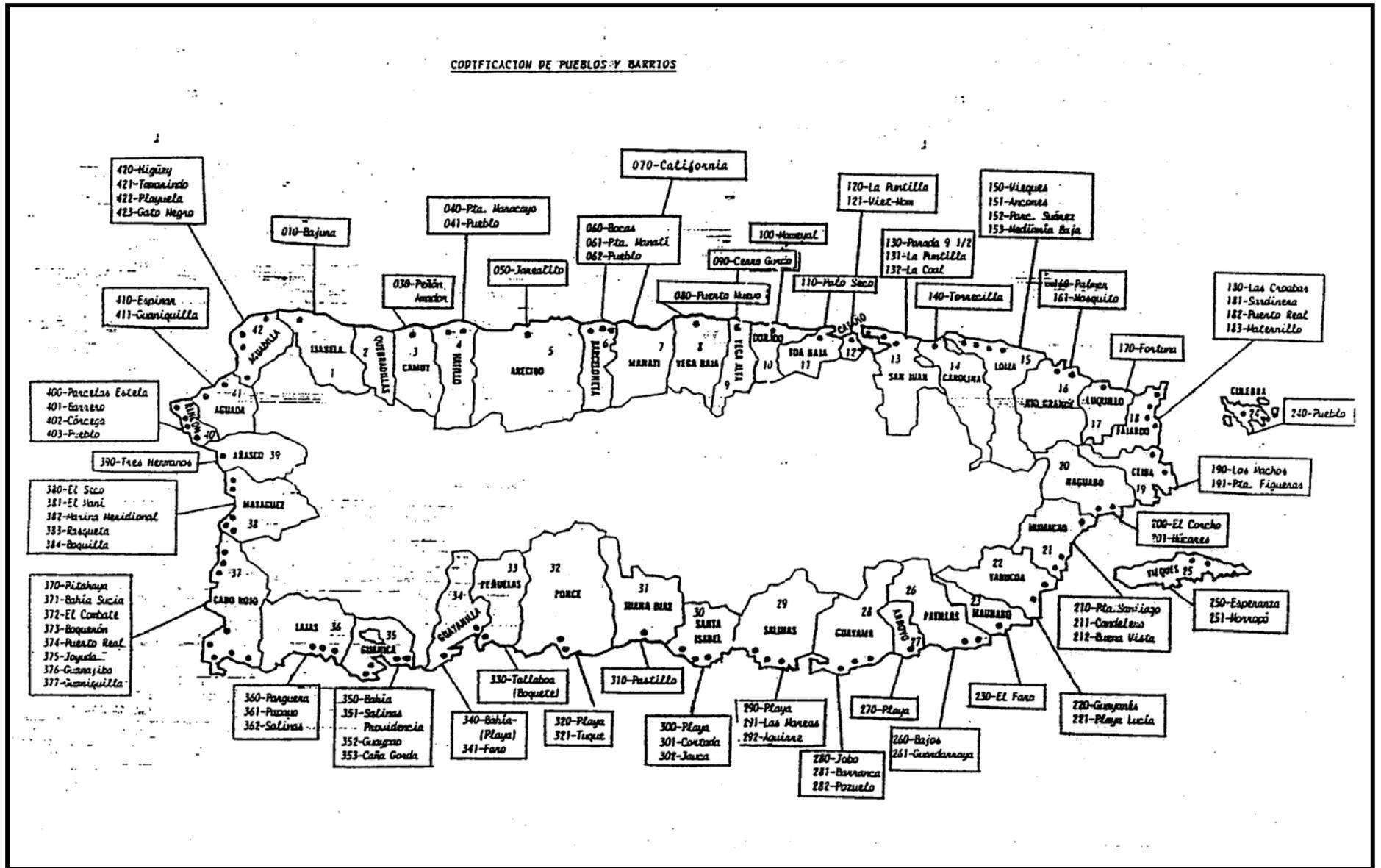


Figure B.1. Coastal municipalities and fishing centers in Puerto Rico.



Gobierno de Puerto Rico
DEPARTAMENTO DE RECURSOS NATURALES
Y AMBIENTALES
LABORATORIO DE INVESTIGACIONES PESQUERAS
P.O Box 3665 Mayagüez, P.R 00681
Tel. 833-2025

Fecha del desembarco ____ / ____ / ____
Mes Día Año

Pueblo _____
Centro de desembarco _____ Uso Oficial _____
Número de salidas _____ Número de horas pescando _____
Nombre del pescador _____
Número licencia del pescador _____
Nombre de proel 1 _____
Número de licencia del proel 1 _____
Nombre de proel 2 _____
Número licencia del proel 2 _____
Profundidad máxima en brazas _____ Profundidad mínima en brazas _____
Nombre del área donde capturó la pesca _____
Pesca capturada a una distancia de la costa:
Mayor de 10 millas _____ Menor de 10 millas _____

CLASE DE PESCADO	PESO	PRECIO POR LIBRA	ARTE	CANTIDAD O TAMAÑO DE ARTE
(226) ATUN ALETA AMARILLA				
(228) BONITO				
(230) VACA				
(229) BACORA				
(225) ATUNES				
(055) BALAJU				
(155) BOQUICOLORADO				
(189) CAPTAN				
(256) CHAPINES				
(128) DORADO				
(064) GALLOS				
(199) JAREÁ				
(115) COJINUA				

LISTA DE PESCADO Y MARISCO CONTINUA AL REVERSO DE ESTA HOJA

Figure B.2. Puerto Rico landings data collection ticket.

CLASE DE PESCADO	PESO	PRECIO POR LIBRA	ARTE	CANTIDAD O TAMAÑO DE ARTE
(116) GUAYMEN AMARILLO				
(118) JUREL OJON				
(109) JURELES				
(192) LOROS				
(088) CABRILLA				
(089) CHERNA				
(091) GUAJIL				
(086) GUASA				
(080) MANTEQUILLA				
(079) MEROS				
(147) MOJARRAS				
(136) ARRAYADO				
(142) BESUGO				
(143) CARTUCHO				
(140) COLIRRUBIA				
(139) CHILLO				
(144) MUNTAMA DE AFUERA				
(138) NEGRA O ALINEGRA				
(134) SAMA				
(130) PARGOS				
(251) PEJE PUERCO				
(202) PICUAS				
(164) PLUMAS				
(076) ROBALOS				
(176) SALMONETE AMARILLO				
(175) SALMONETE COLORADO				
(036) SARDINAS				
(234) SIERRA ALASANA				
(233) SIERRA CARITE				
(008) TIBURONES				
CLASE DE MARISCO	PESO	PRECIO POR LIBRA	ARTE	CANTIDAD O TAMAÑO DE ARTE
(906) CANGREJOS MARINOS				
(900) CARRUCHO				
(904) JUEY DE TIERRA				
(901) LANGOSTA				
(903) OSTION				
(902) PULPO				
(905) OTROS MARISCOS				

Figure B.2. (Cont.) Puerto Rico landings data collection ticket.